NATURE

Vol. 142 SATURDAY, NOVEMBER 12, 1938 No. 3602

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Editorial and Publishing Offices:
MACMILLAN & CO., LTD., ST. MARTIN'S STREET, LONDON, W.C.2.
Telephone Number: Whitehall 8831 Telegraphic Address: Phusis, Lesquare, London
The annual subscription rates are: £2 12 0 British Isles, £2 17 0 Foreign, payable in advance
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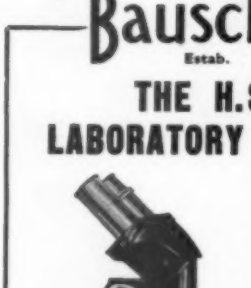

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LONDON, W.C.2

NATURE

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 142 SATURDAY, NOVEMBER 12, 1938 No. 3602

Human Evolution and Mechanization

IN an address* at the end of last year before the American Society of Mechanical Engineers, Prof. Earnest A. Hooton, of the Peabody Museum, Harvard University, surveyed the course of evolution in the primate stem, regarding it as a series of adaptations in a progression towards the specifically human attributes of tool-making and tool-using. He showed how each of the modifications in structure, such as the development of the hand, with its opposable thumb and sensitive finger-tips, of the foot as a movable point of balance, of upright stature, with the consequent visceral readjustments, of stereoscopic vision and of the central nervous system and the changes in form, size and complexity of the brain, were all antecedent conditions in the attainment and elaboration of a material culture. The results of recent observation and experiment with monkeys and apes have also shown how structure and mentality in each branch of the pithecoids has militated against the attainment of anything more than some rudimentary form of mechanical achievement, while the failure to develop an articulate language has precluded the passing on of experience and acquired knowledge, which is an essential element in human cultural progress.

We will not attempt to follow Prof. Hooton in detail as he traced the influence of the invention of tools from the time when it relieved man of the necessity of further structural adaptation in the struggle for survival—tools, as he says, made organic adaptation obsolete—to the dominance of the machine in modern civilization. There are, however, two points which call for special consideration. Of these, the first is a development of the familiar principle that disuse of an organ leads to its atrophy. Prof. Hooton suggests that when human evolution emphasized cerebral development, it diverted nutriment from other parts of the body, and the less active organs diminished in size. While, however, he goes on, no man has need of the strength of the ape, he ought to need the brains of a man; he should not be able to survive with the brains of a moron. The machine and mass-production of modern civilization favour the survival of the physically unsound and the mentally impotent by relieving mankind of the opportunity, or indeed the necessity, for physical and mental exercise. The second point maintained by Prof. Hooton is that invention is the product of the individual and is accepted with reluctance by the many, if indeed it be not actually suppressed, though the conservatism of the masses is responsible for the preservation and stability of the culture already achieved.

Prof. Hooton intentionally paints in darkest colours the picture of present-day trends in mechanized society, which he regards as rushing headlong along the downward path on a well engineered road. Man's mechanized science, he says, has so far outstripped his biological status and social ideals and behaviour that it has become a menace. What we must do, he concludes, is to direct a modicum of that high intelligence and creative ability, which is too much monopolized by mechanical science, to the study of ways and means of repairing and improving the human machine.

With this conclusion all will be in hearty sympathy, especially in so far as it implies the building of a better race and the study of the

* "The Simian Basis of Human Mechanics or Ape to Engineer". The Tenth Henry Robinson Towne Lecture delivered at the Annual Meeting, New York, N.Y., Dec. 6–10, 1937, of the American Society of Mechanical Engineers. Reprinted from *Mechanical Engineering* of January 1938, *Antiquity* of June 1938.

capabilities stored up in our species through the millions of years of primate evolution which have culminated in man. At the same time, certain comments present themselves for consideration. It is possible to exaggerate the deadening effect of mechanization on the human mind. Much depends upon the individual and his character, qualities and interests. In the days before mechanization, it was the deadening effect of manual labour of any kind, now contrasted with mechanization, which was blamed, and often not unjustly, for the inertia and the baseness of the masses in our population. They always have been and always will be coarse in some degree, while they are unleavened by the desire and the opportunity for self-development. Such an opportunity must now come in our modern civilization through the development of a regulated mechanization, which will give labour the necessary leisure.

But again, surely the moron-like character of the 'base mechanic' is much exaggerated. The mental and social effects of mechanization through atrophy of the powers of the mind, and the dangers of passive receptivity induced by gramophone, wireless and the cinema are patent, indeed, but are they really so serious as they are said to be? The introduction of the talking film has placed the cinema more nearly on the level of the theatre as an educative and cultural influence. Its failure is now in its material rather than in its method of presentation—this does not refer to natural history and other instructional films—and the shortcomings of the film as drama are being remedied rapidly. Both cinema and wireless now reach thousands, where formerly the theatre, music and literature influenced hundreds, or it may be only tens. The effect is to be seen around us everywhere in daily life in a raising of the general cultural level. Nor is individual performance likely to be seriously affected. Photography and the gramophone were, it was feared, to put an end in turn to painting and music. Both have helped the development of these arts, and the understanding of their principles, while as regards the individual executant, they may possibly have eliminated a few who never would have attained perhaps even a mediocre competence.

In a sense, new inventions are the work of an individual, yet in all but backward cultures the individual, unless in exceptional instances, is the spear-head, while the general cultural level of society is the shaft of the spear. The individual gathers up the threads of a general cultural trend. This applies even in highly specialized branches of thought, as, for example, when a whole body of scientific workers is proceeding along certain general, but related, lines of development. Darwin was indebted to a general drift of philosophic and scientific thought and speculation, which had been incubating for a generation or more before his time. Only in the more primitive type of society existing in complete isolation could such conditions as Prof. Hooton pictures prevail—a society in which innovation by an individual would be suppressed, or adopted only with extreme reluctance by the conservative masses. Cultural advance is usually a process of cross-fertilization, that overcomes by one means or another the natural conservatism which is undoubtedly a prominent feature in the make-up of a primitive group. The effects of such cross-fertilization of cultures can be seen in the processes of growth of all the great civilizations of the Old World. Of its advantages and disadvantages we are ourselves, perhaps, the most conspicuous example.

What may be termed the humanization of future progress in a mechanistic world—a world in which, as Western civilization spreads more and more widely to the peoples of less advanced culture, mechanization will increase rather than diminish—is more likely to be brought about by a cross-fertilization of the existing cultures of the different peoples of the world than by internal development of a nationalized ideal. For while the nationalized ideal *ex hypothesi* is separatist in tendency, it is only by a general pooling of ideals and ideas, such as for example in the biological study of man which Prof. Hooton rightly desiderates, that we can hope to solve the problems threatening world civilization, problems ranging from those of currency and the distribution of a food supply, now running to waste, to that which must be the pre-occupation of us all, the preservation of peace.

Finally, a word as to the biological study of man, to which Prof. Hooton would direct some of the creative energy now devoted to the interests of mechanization. It is difficult to avoid the conclusion that in the application of scientific investigation to the problems of man's future and the planning of human relations—which must come, if the world is not to drift into a worse chaos than that of the present time—the study of human heredity in all its aspects will play an important part. How far the study of eugenics, as at present pursued, will enter into the attack on this problem is an open question. Who is to decide what is the

type to which to breed? Further, the proliferation of the alleged inferior classes of the population is, after all, only in accordance with Nature's method of ensuring in any species that out of an innumerable progeny the fit shall survive. This is not an argument in favour of the physically and mentally degenerate; but the history of English society is the last which should be called on to testify that the product of any one grade is 'inferior'. If, however, it is maintained that such an excess in numbers of offspring constitutes a social burden, the argument is removed from the biological to a sociological plane and constitutes a problem of a different character.

Dialectical Materialism in Biology

Biology and Marxism

By Prof. Marcel Prenant. Translated by C. Desmond Greaves. Pp. xxiii + 223. (London: Lawrence and Wishart, Ltd., 1938.) 10*s.* 6*d.* net.

MANY readers of NATURE will ask what Marxism has to do with biology. It would be possible to write a volume on the economic influences which have done much to determine the course of biological research. For example, botany was at one time largely concerned with medicinal herbs. The greatest age of systematic botany was that of the crude exploitation of Colonial floras, and interest in plant genetics arose with the need for improvement in Colonial plants, such as Canadian wheat and Javan sugar-beet.

But Prof. Prenant's book is an attempt to apply to biology the principles of dialectical materialism, the philosophy of Marx, Engels and Lenin. It was written for working-class students to whom Marxism is already familiar, and not primarily for biologists. Nevertheless, every biologist who recognizes that Marxism, whether true or false, is an important philosophical movement, will find the book extremely interesting.

The author points out that Marxist ideas are peculiarly applicable in biology because both biology and Marxism are concerned with change; and he is primarily concerned with evolution, both individual and social. Here Marx's and Engels' criticism of Darwin, whose results, as a whole, they accepted, is of great interest. In 1878, Engels wrote, "Darwin, when considering natural selection, leaves out of account the causes which have produced the variations in separate individuals, and deals primarily with the way in which such individual variations gradually become the characteristics of a race, variety, or species". On the other hand, many biologists will consider the criticism of Darwinism quoted on p. 194 less valid.

It is particularly interesting to see how a modern Marxist tackles some of the outstanding problems of biology. A Marxist must be materialistic without falling into mechanism, and Prof. Prenant certainly does his best to steer a course between the Scylla of epigenesis and the Charybdis of preformationism when discussing theories of embryonic development. In his account of heredity, while admitting the main results of the Morgan school, he stresses the importance of the cytoplasm, and above all the fact that at no time can the chromosomes be regarded as independent of their surroundings.

In my opinion, Prof. Prenant under-estimates the importance of selection for man. It is true that natural selection, in the strictly Darwinian sense of selective killing, has been largely replaced by what Karl Pearson called reproductive selection, based on differential fertility. However, under this new form, selection is perhaps as important as ever; and Dr. Needham's critical notes show that there is plenty of room for divergence between Marxist biologists on quite fundamental questions.

Indeed, should interest in Marxism spread, as appears to be probable, there is no doubt that biological and other scientific problems will be more and more discussed from a Marxist angle. That this need not involve any slavish acceptance of Marxist writings as 'gospel' will be clear to any reader of Prof. Prenant's statement (p. 198) that "in explaining life as an innate property of protein Engels was straying from the dialectical path". Provided Marxists are willing to follow this example, I do not think that non-Marxist biologists need fear an attempt to impose Marxist dogmas on science, such as probably occurred in some quarters in the Soviet Union between 1922 and 1932; and they may even admit that Marxism makes for a novel approach to certain problems which is bound to stimulate thought and experiment.

The translation is almost uniformly excellent, and the publishers may be congratulated on a book which will certainly interest Marxists in biology, and should also interest many biologists in Marxism.

J. B. S. HALDANE.

Challenge to Ten

Duodecimal Arithmetic

By George S. Terry. Pp. viii+407. (London, New York, and Toronto; Longmans, Green and Co. Ltd., 1938.) 30*s*. net.

THIS handsome volume of tables is one of the most astonishing books ever composed by an enthusiast. The practical advantages of twelve over ten as the base for everyday reckoning in any community which has progressed beyond counting on the fingers are obvious, and almost every language has a word for a dozen. So far as the change from one base to another depends on the schooling of a single generation, it could be effected by a stroke of a governmental pen. Unfortunately, ten dominates not only our habits but also our records, not only our present means of computation but also our inheritance of tables. Converted to a belief in duodecimals by Emerson Andrews's "New Numbers", and perceiving more clearly than many advocates that the issue is not theoretical, Mr. Terry applied himself forthwith to the task of reducing the handicap by which any rival of the decimal system is delayed at the start, by providing a comprehensive collection of tables in the scale of twelve.

As a practical man, Mr. Terry begins with adequate tables for conversion between the scales of ten and twelve, but except in these tables the work is duodecimal throughout. The tables include square roots of n and $12n$ and cube roots of n, $12n$, and 12^2n to 6 places from 12^1 to 12^3, reciprocals to 16 places as far as 12^3, 9-place logarithms to base 12 at interval of $1/12^3$, natural logarithms, circular functions and their logarithms, exponential and hyperbolic functions, the exponential integral and the sine and cosine integrals, the factorial function and its logarithmic derivative, and Bessel functions of orders 0, $\frac{1}{2}$, and 1. Attention is paid everywhere to interpolability, and the volume ends with a number of tables of interpolation coefficients.

Some of the tables were calculated directly in the scale required, and some were obtained by the conversion of standard decimal tables. In all cases, the ample margin of three places beyond those published was reserved, and the tables were differenced before being cut down. The volume has been produced by reproduction of typescript; this method eliminates many sources of accidental error, and is seen here at its best, the typist having evidently been aware of responsibility for the appearance as well as for the accuracy of the pages.

Mr. Terry's task could not have been performed more modestly, more efficiently, or with better judgment. Nevertheless, such is the obstinacy of humanity that it is only too likely that when the millennium has come at last, five gross and eight more years must elapse before the universal adoption of duodecimal arithmetic. E. H. N.

Analysis of Explosives and Matches

Explosives, Matches and Fireworks

By Prof. Joseph Reilly. (Section of Lunge and Keane's "Technical Methods of Chemical Analysis", Second Edition Vol. 4.) Pp. xi+172. (London and Edinburgh: Gurney and Jackson, 1938.) 7*s*. 6*d*. net.

THE general arrangement of this work is the same as in the first edition of Lunge and Keane's treatise which was published in 1911, but the section on explosives, which previously was by the late Oscar Gutmann, has been rewritten entirely by Prof. Reilly. The directions in this section are clear and practical, and numerous references are given, so that the reader can obtain more detailed information. Stability tests occupy twenty-four pages, and of these the Abel heat test takes seven, whereas the other forty-three methods dealt with have only seventeen pages between them. In many cases only the general character of the test has been given, but as the chemical practitioner will seldom be called upon to carry them out, this is no doubt sufficient.

The sections on matches and fireworks in the first edition were written by Dr. A. Bujard, of Stuttgart, and the English translation was revised by E. G. Clayton. Prof. Reilly has rewritten most of the earlier parts, dealing with woods and waxes for matches, phosphorus and the composition and manufacture of glue, but the rest of the matter is almost unchanged since 1911. Of the fifty-one and a half pages devoted to matches, twenty-five deal with glue and other binding substances.

Nearly all technical works dealing with fireworks are unsatisfactory, and that of Bujard and Clayton was no exception. It is therefore to be regretted that the section has not been rewritten. On p. 149

are given some coloured fire mixtures containing potassium chlorate and sulphur, and there is a green-star mixture specially recommended by Clayton containing realgar as well. On p. 151 Prof. Reilly has added the words: "The use of chlorates is restricted in mixtures on account of their sensitiveness and has been made illegal in some countries." This is too mild, as mixtures containing chlorate together with sulphur or a sulphide have been forbidden definitely for fireworks since 1894 in Great Britain, and are classified as "fulminates". If one of the ingredients be sulphide of arsenic (realgar) the composition is specially dangerous. Many fatal accidents have been caused by such fireworks.

Mercury fulminate and detonators are dealt with twice—in the explosives section and again in that dealing with "Primings and Fireworks"—but the word "fulminate" does not occur in the index, and against "mercury fulminate" there is only reference to the fireworks section. The latter contains a description of the Esop test for detonators, which is inaccurate and confused.

The first two thirds of this book are very satisfactory, but unfortunately this cannot be said of the remainder. A. M.

General Scientific Knowledge

Van Nostrand's Scientific Encyclopedia

Pp. v + 234. (London: Chapman and Hall, Ltd., 1938.) 50*s*. net.

THIS encyclopædia is stated to cover the basic sciences of chemistry, physics, mineralogy, geology, botany, astronomy, and mathematics and the applied sciences of navigation, aeronautics and medicine and the three branches of engineering, civil, mechanical and electrical. To do this, even when as many as 10,000 separate articles, each of between 100 and 1,000 words, are allowed, necessitates a good deal of selection, abbreviation and omission. The authors and publishers plead, in the preface, for indulgence for such omissions; they write: "The exercise of judgement in the selection of material was unavoidable and it was necessary to maintain a limit of difficulty beyond which it was impracticable to go in attempting to cover so broad a field within the physical confines of one useful volume." To grant this indulgence seems but just.

The information given is, on the whole, accurate and trustworthy; but in some instances the obligatory brevity may give the reader a wrong impression, and occasional statements are, to say the least, controversial. Each little article is logically written, beginning with a simple definition which is afterwards developed, and the more complex concepts are then discussed. Every term explained in the volume is printed in bold type wherever it is used significantly in the course of articles on other terms. This system of cross reference is a useful and helpful feature of the book. No provision, however, is made for those who wish to pursue a subject further; a few references to standard works might have been included at the end of the more complex articles. True, there would be difficulty in selecting suitable references: but the authors have had to exercise their powers in this direction throughout the preparation of the whole work.

The authors are all associated with American academic institutions, and naturally American practice and views are reflected in many of the articles. The responsibility for each science has been left largely in the hands of a single author for the sake of unity; but in each instance a number of others has worked with the author and a group has acted in an advisory capacity.

In a work of this nature, some inconsistencies are bound to occur; for example, some three pages are devoted to an article on chemistry; but no entries at all are to be found under such headings as "physics", "biology" or "medicine"; some indication of the scope of these subjects might have been given with suitable cross references. Despite all that is often said about the absurdities of placing the different branches of science in watertight compartments, it is still necessary to define their scope both for academic and for economic reasons. Each university authority appears to have clear notions as to the dividing line between various branches of science, although they are not always in common agreement. Again, admission to membership of the various professional scientific and engineering bodies normally involves the decision of some committee as to whether a man is a chemist, physicist, electrical engineer and so forth, and cases are frequent when a man is elected to several such bodies, demonstrating his versatility or may be the difficulties of dividing science into professional groups. Whilst for many purposes several such individual organizations are advantageous, one representative and respected body able *and willing* to speak for science as a whole, and perhaps also engineering, is likely to achieve more. There appears to be a growing desire to have such a body, as the recent activities of the British Association for the Advancement of Science

has proved. But this is digressing—the point to be stressed is that the boundaries of the various branches of science have been defined, and some indication of these definitions, artificial and changeable as they may be, should, in the reviewer's opinion, have been included in such an encyclopædia. It is interesting to find NATURE and the *Philosophical Magazine* are classified on p. 249 under *chemical* journals, while the Royal Society heads the list of chemical societies!

The printing is excellent and is in double column with clear headings. The illustrations are clear and helpful and some pleasing coloured plates are included. The book is well produced and, considering its 1,200 pages, is not too bulky for convenient handling. It will form a valuable addition to the libraries of teaching institutions and be of considerable help to those private individuals, who can afford it, requiring a reference book of science. H. R. L.

Gulf Coast Oilfields

Gulf Coast Oil Fields:
a Symposium on the Gulf Coast Cenozoic. Edited by Donald C. Barton and George Sawtelle. Pp. xxii+1070. (Tulsa, Okla.: American Association of Petroleum Geologists; London: Thomas Murby and Co., 1936.) 4 dollars; 18*s.* 6*d.*

AT the Houston convention of the American Association of Petroleum Geologists held in March 1924, an attempt was made to give a comprehensive picture of American salt domes. Papers included descriptions of oilfields, theories as to their origin and a general summary of research carried out to that date. In 1926 these papers were published by the American Association of Petroleum Geologists in the form of a symposium entitled "Geology of Salt Dome Oil Fields".

Since that time a wealth of new information and discoveries concerning Gulf Coast geology has come to light. In fact, developments during the intervening decade have been far more rapid than during the quarter century which preceded publication of the original volume. At the 1933 convention of the Association at Houston a series of papers was presented which reflected the trend of progress at that time, and these have formed the nucleus of a further volume under the above title recently published. Other important papers have been added to make the whole symposium representative of what is in reality a new era of Gulf Coast geology.

The work comprises in all forty-four papers grouped under three headings: general and theoretical papers, stratigraphy, descriptions of oilfields and salt domes. The last group is subdivided into four regions: South Texas, South-east Texas, Southern Louisiana and East Texas. An unusual frontispiece to this book is a mosaic of parts of forty aero-photographs, taken at heights of approximately 12,000 ft., of Barbers Hill Salt Dome, Chambers County, Texas; to facilitate accurate reading of this frontispiece the significance of various elements of the picture are indicated and instruction given in the correct interpretation of this and similar aerial photographs.

D. C. Barton points out in a foreword to the volume that application of geophysical methods of prospecting was largely responsible for the incidence of the new era of Gulf Coast history. Half-way through the period under review the number of known domes had been doubled by torsion balance and seismograph discoveries and an intensive refraction campaign was being conducted. Then after a short lull due to economic depression, to the flood of oil from East Texas and decline in geophysical successes, three important discoveries in Texas and Louisiana confirmed the theory that deep dome structures are more prolific than shallow ones and easier to prospect. The rate of exploration afterwards became the fastest in the history of the Gulf Coast. The area of potentially good production was vastly increased, production zones were deeper and the depth of drilling almost doubled. In 1924 production of crude oil was 30 million barrels. In 1934 it was 94 million barrels and in the first half of 1936, 25½ million barrels were produced from southern Louisiana alone.

It seems almost impossible that this rate of progress should be maintained, but D. C. Barton predicts some interesting developments in the coming decade. Of these perhaps the most spectacular is that wells to a depth of 20,000 ft. or more may be mechanically feasible and not commercially impracticable. Moreover, in his view there will be progressive improvement in geophysical technique, with the possibility of detecting commercial accumulations of oil and gas by direct method and prior to drilling, though probably not at great depth. Increased efficiency in recovery of crude oil from sands, increased production of gasolene, kerosene and diesel oil from a given quantity of crude oil, conversion of natural gas into gasolene by polymerization and increased efficiency in the consumption of petroleum products as motor fuels, will all combine to make the next decade as prosperous as the one that is just past.

An Introduction to the Scientific Study of the Soil By Prof. Norman M. Comber. Third edition. Pp. vii+206. (London: Edward Arnold and Co., 1936.) 7*s*. 6*d*. net.

WHILST no outstanding changes have been made in the third edition of Prof. Comber's deservedly well-known book, its subject-matter has been brought fully up to date without sacrifice to the conciseness and clarity of the original text. The book is intended for agricultural and horticultural students, that is, those whose interest in the soil has a strong practical bias; nevertheless, the scientific point of view is maintained so consistently in each chapter that the student is led to think of the soil as much from the pedological as from the purely practical point of view. Indeed, the greater part of the book is concerned with the study of soil as a natural entity, quite apart from the problem of its agricultural utilization. It is perhaps the chapters dealing with the main facts of soil physics and soil chemistry that help the reader most to bridge the apparent gap between the scientific and the practical approach to the study of soil.

The scientific point of view from which the book is written is typified in the title of the penultimate chapter on "The Artificial Treatment of the Soil", in which the effects of common cultivation practices on soil fertility are briefly reviewed. In this section a useful account of the replicated plot system used in modern field experiments is also given. The chapter on soil water is a good example of the author's facility in stating main facts and definitions, which are apt to be lost sight of in the more advanced literature of soil science. Useful advice on how to use the latter is given at the end of the book, but in the text itself there are practically no references to the sources of the works which are quoted. The inclusion of such references would be surely welcomed by what Prof. Comber describes in his preface as "botanists, ecologists and others besides agricultural students", who are partly responsible for the demand for a third edition of this extremely useful book.

A. J. L. L.

The Organisation of Agriculture: with Applications to South Africa. By Prof. Hubert D. Leppan. Pp. v+83. (Johannesburg: Central News Agency, 1936.) 4*s*.

ONE of the most urgent of many tasks confronting South Africa is to save the soil. The causative evils most frequently cited are faulty pasture management, particularly overstocking, and cultivation of unsuitable land. Behind these lie racial, social and political causes that have influenced the development of South African agriculture. A complete re-organization of agriculture is now imperative.

Prof. Leppan considers that in a policy of land utilization concentrating almost entirely on properly organized animal husbandry lies South Africa's chief hope of salvation. He traces the past policy of encouraging cereal production, assisted by export subsidies, tariffs and a magnificent elevator system, to the economic consequences of the South African War, and points out that the reverse policy of encouraging cheap grain imports would have the effect of increasing soil fertility, thereby helping to save the veld from erosion. The imported feeds would be used to relieve pressure on the pastures, and not to carry more animals, which should be fewer and of better quality. More use should be made of cultivated land in producing animal rather than human foods. The meat market could be enormously extended, and the demand for maize proportionately reduced, by educating the natives and raising their standard of living.

Prof. Leppan considers that the land in South Africa is overstocked with men as well as with animals, and that a white peasant class is undesirable in South Africa. He recommends fostering urban activities to relieve pressure on the land, and the State purchase of derelict farms which might be rented on long leases with due safeguards against overstocking and other maltreatment. All economic and political measures, however, are useless unless they are supplementary to controlled veld management.

G. V. J.

The Physical Basis of Geography: an Outline of Geomorphology. By Dr. S. W. Wooldridge and R. S. Morgan. (University Geographical Series.) Pp. xxi+445. (London, New York and Toronto: Longmans, Green and Co., 1937.) 12*s*. 6*d*. net.

IN the first part of this book, the authors have deliberately 'taken sides', in an endeavour to place much-debated topics in geophysics and tectonics clearly before the student. For example, Wegener's continental drift theory is presented in a much more favourable light than customary. No harm will be done to the student by this method of treatment provided he realizes that he is receiving one point of view. Incidentally, it is pleasant to see that regrettable term "betwixt-mountains" somewhat frowned upon.

The second and more important part of the book has a different tone. Here the central theme is the cycle of erosion as conceived by W. M. Davis and elaborated and modified by Johnson and others. The development of landscape under many environments is critically discussed in the light of the orderly sequence of this cycle. Examples of the chronology of denudation, as for example in the Appalachians and the Weald, are fully described. Marine erosion, arid erosion, and erosion in limestone regions are considered. Under this last topic there is given a full account of the development of the land-forms of the chalk in Great Britain—forms in their way as remarkable and as interesting as those of the more fashionable Dalmatian Karst. The book closes with a critical discussion of the influence of glaciation upon scenery, in which the views of the erosionists and protectionists are fairly presented, and with a short account of the possible part played by glacial control in certain major physiographic effects of the Ice Age.

This book, and especially the more important second part of it, should be read by geographers and geologists alike, as it is a sound and critical exposition of erosion processes.

Arctic Harpooner:
a Voyage on the Schooner *Abbie Bradford*, 1878–1879. By Robert Ferguson. Pp. xii+216. (Philadelphia: University of Pennsylvania Press; London: Oxford University Press, 1938.) 9*s*. net.

MR. L. D. STAIR, evidently with great care, has converted the diary of Robert Ferguson into a narrative. It is certainly a readable book, but there is at times the slightest uneasiness in the reader's mind lest the editor may have been carried away by his theme: the feeling is probably unjustified. Matters of precise interest are (*a*) the accounts of the Eskimo and of Ferguson's success on his land journeys, short though they were, due to adopting completely the native mode of life, long before Stefansson, and (*b*) the information regarding the Greenland whale, at that time *the* whale.

Ferguson mentions a whale about 95 ft. long; this can scarcely be correct, since the Rev. William Scoresby, D.D., F.R.S., considered 65 ft. unusual and 70 ft. the absolute limit of size for this species. On the other hand, Ferguson's figure of 130 barrels for this individual seems surprising, but the careful Scoresby measured a whale of 52 ft. which gave 24 tons of oil and says that "whales yielding 20 tons of oil are by no means uncommon" and "whales have been caught that afforded nearly 30 tons of pure oil". He states further that "the ton or tun of oil is 252 gallons wine measure"; this is still the basis of the barrel of whale oil, which is reckoned in round figures at 40 gallons or 6 barrels to the ton. These whales therefore gave 120–180 barrels, which would be most remarkable for the gigantic Blue whale of the South. It should be mentioned on Scoresby's authority that the blubber of the Greenland whale is from 8 or 10 to 20 inches thick.

J. E. Hamilton.

Industrial Chemistry
an Elementary Treatise for the Student and General Reader. By Prof. Emil Ramond Riegel. Third edition. Pp. 851. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1937.) 28*s*. 6*d*. net.

PROF. RIEGEL'S book provides an admirable survey of modern industrial chemistry which is suited to the needs of the student and the general reader. The various sections have been written with the collaboration of experts and give in a concise form a wealth of authoritative information. The topics include mineral acids and alkalis, nitrogen products, phosphates, fertilizers, cements, ceramics, glass, fuels, water, coal products, electrothermal and electrolytic processes, petroleum, and the important organic chemical industries such as the manufacture of dyes, pigments, oils, explosives, rubber, etc. There are also good chapters on chemical plant and instruments of control, and on the metallurgy of iron and steel, copper and other common metals, and on the platinum metals and radium. The treatment is sufficiently detailed to be really useful, and the book is well illustrated and indexed. There are references to standard treatises and to recent articles in journals—the latter mostly American.

Physikalische Methoden in Chemischen Laboratorium
Pp. v+267. (Berlin: Verlag Chemie, G.m.b.H., 1937.) 3.60 gold marks.

DURING 1936–37, a series of thirteen articles on the application of new physical methods to the solution of chemical problems appeared in the German technical journal *Angewandte Chemie*: these have now been reprinted and collected in the book under review. The subjects treated are X-ray methods, ultra-sonic waves, chromatography (three articles), Raman effect, dielectric loss, spectrum analysis (two articles), polarographic methods (two articles), photo-electric spectrophotometry, and colorimetry with colloidal solutions. Some of the articles, for example, those on the application of X-ray methods and of ultra-sonic waves, are mainly concerned with a description of the results obtained, but in others, as those on chromatography and the polarograph, adequate experimental details are given. The authors of the various sections have had practical experience of the subjects about which they have written, and so the matter may be regarded as authoritative, although, as is to be expected, the style is not uniform. Altogether the compilation should prove of considerable interest to chemists who wish to become acquainted with some of the recent developments in experimental technique. The book is well produced, in spite of its paper covers, and is excellent value for its relatively small price. S. G.

The Modern Mind
By Michael Roberts. Pp. 284. (London: Faber and Faber, Ltd., 1937.) 8*s*. 6*d*. net.

THE special interest of this brilliant and well-written essay is the development given to the view that the history of thought shows that there are attitudes of mind corresponding to various historical periods; and that so far as the English mind is concerned, such attitudes are evolutionary products involving the intuitions and inhibitions of our medieval ancestors. This is coupled with the author's effort to re-establish truth as poetry and religion apprehend it, though he seems to think that poetry and religion have no concern with facts at all. In the exposition of these views, the author displays great learning and a gift for discovering striking analogies. However controversial some of his conclusions may be, the reading of his book will be found to be both beneficial and pleasant. T. G.

A Scheme of Inorganic Qualitative Analysis
By Dr. E. M. Stoddart. Pp. vii+39. (London: William Heinemann, Ltd., 1937.) 1*s*. 6*d*.

THIS small manual contains some useful tables for group separations and confirmatory tests. By omitting equations, which the student can find in the text-books of inorganic chemistry, it has been possible to get the material into a small space, convenient for bench use, and to produce an inexpensive guide to qualitative analysis. The book is very clearly written and should prove useful in school and college laboratories. The standard is that of the London Intermediate and General B.Sc.

Foundations of Physics

By Prof. A. S. Eve, C.B.E., F.R.S.

THE relative fields of physics and metaphysics, and the relation of theory or speculation to experiment in the pursuit of natural knowledge, have been the subject of several contributions to NATURE in recent months. In May of last year, under the title of "Modern Aristotelianism", Prof. H. Dingle presented Aristotle and Galileo as examples of opposing schools of thought in a discussion in which the main question raised was "whether the *foundation* of science shall be observation or invention". A month later, NATURE published a special Supplement containing communications from many leading scientific workers on the desirable balance to be maintained between observational methods and deduction by pure reasoning from speculative assumptions. One aspect of this wide subject was developed further in a discourse on "Science and the Unobservable" delivered by Prof. Dingle at the Royal Institution and published as a Supplement to NATURE of January 1 of this year; and this was followed by two articles by Dr. Harold Jeffreys on "Science, Logic and Philosophy" in the issues of April 16 and 23, dealing with relationships between what is understood as idealism and realism. A week later, in an article entitled "The Pragmatic and the Dogmatic Spirit in Physics", Prof. J. Stark attempted to divide physics into two groups or tendencies; and at the same time made an unpardonable attack on the Jewish people in general and Einstein in particular. The article was based upon a communication made by Prof. Stark to *Das Schwarze Korps* in connexion with the movement to purge German science of Jewish influence and was contributed to NATURE by invitation of the Editor in order to obtain an authoritative statement from Germany upon what this influence was supposed to signify.

Prof. Stark's article has been met with cold disfavour by the generality of physicists, who have made no reply to it, deeming that the statements in question carried with them their own refutation so obviously that no answer was required. There was, however, another reason for this silence. Men fear to pour oil, not on troubled water, but on a blazing furnace, which if left undisturbed, might reach exhaustion by its very violence. Yet it may be desirable not to let the case go by default, but to avert strife and discord by an examination of the true state of affairs.

Early in the nineteenth century, Fourier in his "Analytical Theory of Heat" stated the principles which guide us in our scientific outlook:

> "Primary causes are unknown to us; but are subject to simple and constant laws, which may be discovered by observation, the study of them being the object of natural philosophy." He then referred to the triumphs of Galileo and Newton, where so many great effects follow from so few causes, and then continued, "but whatever may be the range of mechanical theories, they do not apply to the effects of heat. These make up a special order of phenomena, which cannot be explained by the principles of motion and equilibrium. . . . Profound study of Nature is the most fertile source of mathematical discoveries. . . . There cannot be a language more universal and more simple, more free from errors and from obscurities, that is to say more worthy to express the invariable relations of natural things. Considered from this point of view, mathematical analysis is as extensive as Nature itself, . . . its chief attribute is clearness; it has no marks to express confused notions. It brings together phenomena the most diverse and discovers the hidden analogies which unite them".

No apology is needed for quoting Fourier—a man who combined observation and theory, and found relations which, to so great a degree and in so many cases, could represent what we believe to be as close an approach as is possible to natural phenomena, which we sometimes rather vaguely call reality.

There are to-day no physicists who do not seek and encourage tests by experiments and observations in order to verify, modify or reject their ideas and theories. Thus, Rutherford said that it would be time to abandon the theory of radioactivity (at first strongly opposed by some great authorities as a most revolutionary idea) as soon as a single, definite, experimental result contradicted it. Einstein actually named and described three fundamental observational results which, if not verified, would necessitate the abandonment of his theory of relativity. Is this dogmatism? Consider, too, how that theory arose. The test experiments of Michelson, Morley and Miller had failed to indicate the swift motion of the earth through the "luminiferous æther" and it was necessary to revise Newtonian mechanics and to bring them into harmony with electromagnetic theory. The efforts of Fitzgerald, Larmor and Lorentz indicated a road which, extended and widened, enabled Einstein to enunciate his great principles of special and general relativity. The experiments of Kaufmann and Bucherer showed that the masses of electrified

particles increased with high velocities, an idea never contemplated by Newton. The relation between energy and mass, the greatest result of our times, largely due to Einstein, has received confirmation in the balance sheet of energy in nuclear transformations. In the field of statistics the Bose-Einstein relation takes high rank in physics with its counterpart the Fermi-Dirac. Nor must we allow prejudice to blind us to the fact that Einstein received his Nobel prize for his discoveries apart from relativity, and indeed his photo-electric relation is one of the most fundamental in the realm of atomic physics.[1]

The history of science is full of remarkable chains of which successive discoveries are the links. Thus, Rutherford surmised the existence and stated the properties of the neutron in 1921. Four years later, Chadwick was writing that the time had come to make a determined search for it—a search which was made in vain until the Curie-Joliots obtained strange and unexpected results when bombarding beryllium with alpha particles, and Chadwick then saw his goal in sight. Would Rutherford be termed pragmatist or dogmatist in 1921 ?

An equally remarkable development came from Faraday's researches. His work on electrolysis needed no development ; it was simple and complete. Not so his work on induction, which required the mathematical genius of Maxwell to bring it to fruition by his remarkable conception of an electric displacement-current in regions devoid of matter, surely a conception as revolutionary as any of our modern ideas. The whole electromagnetic theory was born, and the relation between electricity and light established. Ten years after the death of this great physicist, who blended theory and practice in the highest degree, Hertz started his remarkable and successful investigations on the production of electromagnetic waves, and these radiations were explored by a host of able workers until eventually Marconi achieved his triumphs with far-flung radio messages.

A more remarkable chain of discovery is that which originated with Planck, who found it *inevitable* to believe that energy passed between atoms as quanta, proportional to their frequencies, and thereby succeeded, using the most revolutionary idea of our times, in a rational theory where Wien, Rayleigh and Jeans had in part succeeded, but then met with insurmountable obstacles. To-day, Planck's constant takes a permanent place in physics with other fundamental constants, such as the mass of a hydrogen atom, the electronic charge, or the velocity of light. There must be many who remember the staunch resistance that the quantum theory in its early days met from many most distinguished men of science who to-day accept it as part of the ordinary nature of things—but who dares to say that he understands it ? How rash it would be at any time to trammel or despise those who are working on the fascinating borderline of the known and the unknown.

In due course, Bohr was able to blend the idea of quanta with the electrons around the Rutherford nucleus and to obtain a remarkable theory of radiations for hydrogen, ionized helium, and for X-rays connected with the inner rings of the heavier atoms. His marvellous theory, still the background of the periodic table and spectral analysis, showed signs of cracking in 1925 when applied to numerous cases of atomic radiation. A way out of these serious difficulties has been found by L. de Broglie, Schrödinger, Bohr, Heisenberg, Dirac and others. The problem was one of the most difficult ever presented to the human mind.

It was the many-bodied problem complicated with electric charge, spin and magnetic moment. Complete failure might well have been anticipated, but the remarkable sharpness of many spectral lines, even when powerful magnetic or electric fields were applied by Zeeman or Stark, showed that there was some ordered simplicity in apparent chaos. Following the lead of experimental results, certain rules were formulated so that equations were found, showing something in the nature of standing waves which indicate the probable position of the electron at any time. These equations approach reality in the sense that they give the right answers ! It is as though a man used logarithms without understanding the theory underlying them.

The fact that physical interpretation lags far behind the mathematical calculation (which are nevertheless based on experimental results) in no wise detracts from the work of these men of genius, who belong to various nationalities. If these men are to be deemed dogmatists, then it would indeed be an honour to be included in their ranks. But the whole theory of pragmatists and dogmatists is pure moonshine and to link such discoveries mainly with the Jewish people is a poor compliment to the rest of mankind.

A more just estimate of the true situation is that due to Maurice, Duc de Broglie, who wrote in Nature of May 7, 1933 :

> "Recent theoretical views suggest that a mechanistic view of Nature cannot be pushed beyond a certain point, and that the fundamental laws can only be expressed in abstract terms, defying all attempts at an intelligible description. The philosophy of science has always swung between these two points of view. The work of the great physicist [Rutherford] to whom these lines are dedicated shows, however, to what brilliant discoveries the method followed by Lord Rutherford can lead."

There are, nevertheless, many great leaders, notably Bohr, who believe that we are still merely approaching the problem and that in due course the reasons for the correctness of the quantum theory and wave mechanics will be made clear. This further step, if it is ever achieved, will not detract from the fame of the present pioneers. At least it has been made certain that novel ideas, due to many great men of science, often revolutionary in type, have first been scorned and later accepted, but there has certainly never been any necessity for what has been called 'advertising'. Let us name Copernicus, Galileo, Newton, Fourier, Maxwell, Planck, Rutherford, Bohr, Einstein. Other names might be added of men whose just fame is not yet so firmly established, men belonging, too, to various nationalities—a matter of no real importance in science.

Rutherford, indeed, frequently lectured on his discoveries to a variety of audiences in many countries all over the world. He believed that it was one of his duties to interpret and spread the good news of scientific discovery and progress. He would be a rash man who dared to use the word 'advertising' in this connexion, and no fair-minded man will connect the word with Einstein, for his views quickly and naturally caught and held the attention both of the well-informed and the general public.

Although Rutherford made no incursions into wave-mechanics and held fast, wherever and as long as he could, to classical views, yet he was honest enough to admit when the latter failed, and he was eager to adopt anything, however modern or revolutionary its source, which might assist him in his research work, such as the use of resonance to secure low-voltage transmutation, an idea due to Gamow, and to Condon and Gurney (1928), derived from wave-mechanical theory and impossible from a classical viewpoint. We must also admire that abstruse analysis of Dirac, involving negative energy, which led him to the conception of a positive electron before its discovery in cosmic rays by Anderson and its confirmation by Blackett. Here, as in so many cases, ideas which might be termed 'dogmatic' by some have led directly to the pragmatic. In fact, theory based on experiment or observation (and who bases it on anything else ?) will often yield results at first unexpected, just as Faraday's experiment led through Maxwell's theory to wireless telegraphy, telephony and broadcasting on one hand and to our gigantic power houses and electrical supply on the other.

That is the gist of the whole matter and there is nothing more to be said. The search for truth or 'reality' is common to all, but there may be different avenues of approach. Let us throw these open without hindrance and give full credit to all who extend by any means our natural knowledge, setting aside all prejudices and determined that the rule of reason and the law of liberty shall prevail throughout the realms of science.

[1] See also Prof. C. G. Darwin's presidential address to Section A (Mathematics and Physical Science) of the British Association, delivered at Cambridge ("The Advancement of Science, 1938." London: Burlington House.)

Sir William Herschel, 1738-1822

By Sir Frank Dyson, K.B.E., F.R.S.

AT the age of thirty-five years, William Herschel, a distinguished and prosperous musician, was impelled to explore the heavens. He found a small telescope which he had hired insufficient for his needs, and with great skill and patience constructed larger and larger instruments. After his day's work, he spent a great part of the night observing the stars. The conclusions he drew from his observations were characterized by an originality, boldness and splendour of outlook which have placed him among the greatest astronomers. "We ought", he writes, "to avoid two opposite extremes. If we indulge in a fanciful imagination and build worlds of our own we must not wonder at going wide from the path of truth and nature. . . . On the other hand, if we add observation to observation, without attempting to draw not only certain conclusions, but also conjectural views from them, we offend against the very end for which observations ought to be made. I will endeavour to keep a proper medium; but if I should deviate from that, I could wish not to fall into the latter error."

Frederick William Herschel was born at Hanover on November 15, 1738. His father was a hautboy player in the Hanoverian Guards, and at the age of fourteen William was engaged as a musician in that regiment. He left in 1757, as he had taken no oath binding him to military service. He received a formal discharge in 1762. The legend that he deserted from the army, and received a pardon from George III in 1782, is a fiction.

Towards the end of 1757, Herschel came to England and for some time had hard work to earn a living by copying music and giving occasional performances. His musical abilities were gradually

recognized, and in 1760 he was appointed instructor of the band of the Yorkshire Militia stationed at Richmond. In 1762 he resigned this post; he composed symphonies, conducted concerts at Leeds, was for a short time organist of the Halifax parish church, until in 1766 he became organist at the Octagon Chapel at Bath. He was soon the centre of musical activity in this fashionable watering place and had a busy life, composing, conducting concerts and taking pupils.

As music was not sufficient for his boundless energy, Herschel studied Italian, Greek, harmonics, mathematics, optics and astronomy. In 1773, he hired a small telescope and commenced to search the heavens. He soon wanted a larger telescope, and after many experiments and failures succeeded in making a Newtonian reflector of six and a half inches diameter and seven feet focal length. The parabolic mirror was of speculum metal in the proportion of 5 lb. of tin to 9 lb. of copper. He cast the disk himself, ground it and polished it with his own hands. With this instrument, he repeated and extended a previous survey of the heavens. His intention was to find bright stars with faint stars near them, on the supposition that the difference of magnitude was the effect of distance and might thus serve to determine stellar distances.

On March 13, 1781, Herschel made this entry in his note-book: "In the quartile near ζ Tauri, the lowest of the two is a curious either nebulous star or perhaps a comet". After several cloudy nights, he found on March 17 that the star had moved and was presumably a comet. He communicated his discovery to Maskelyne, the Astronomer Royal, who wrote to him on April 23: "It is as likely to be a regular planet moving in an orbit nearly circular round the Sun as a comet moving a very eccentric ellipsis. I have not seen any coma or tails to it". The evidence of its great distance and uniform movement soon showed that the body was, in fact, a new planet. This was an astounding discovery, as no one had ever imagined there could be more than the five planets Mercury, Venus, Mars, Jupiter and Saturn, which had been known for ages. Herschel was awarded the Copley Medal of the Royal Society in November 1781 and was elected a fellow of the Society in December.

The attention of George III was directed to the fame of the Hanoverian astronomer, with the result that Herschel was appointed King's Astronomer with a salary of £200 a year. He was now relieved of the necessity of snatching astronomical observations in the intervals of concerts or sitting up all night after a hard day's work. He had at this time a 7-foot telescope of 6 inches aperture and a 20-foot telescope of 12 inches aperture. He now proceeded to make a 20-foot telescope with an 18-inch speculum, and commenced his famous 'sweeps' to find what was in the sky and to gauge the depths of the heavens. Some years later, he constructed the great 40-foot telescope with a 40-inch speculum. Before he had made the flat mirror so as to use the telescope in the Newtonian form, he looked down the tube directly with his eyepiece and found the definition good, and the brilliancy greater owing to the absence of a second reflection. He accordingly adopted what is known as the "Herschelian" type of reflecting telescope in later work.

Herschel continued his observing with, if possible, increased vigour, finding in his 'sweeps' objects which enrich the natural history of the sky and classifying them according to their species, hundreds of double stars, thousands of clusters and nebulæ. Double stars attracted him because he hoped to find a parallactic displacement between a bright star and its faint neighbour, and thus obtain an idea of stellar distances. He published a list of 269 double stars in 1782, giving their position angles and their angular distances apart inferred roughly from the size of the disks. In 1784 he published a further list of 484 stars, with their distances apart now measured by a micrometer. He seems to have suspected that some of them might be real binary systems. By 1802 he was satisfied from the changes in position angle that a considerable number of these stars were binary systems moving in elliptic orbits under their mutual gravitation. Newton's law thus held in these distant regions in space.

In 1760 Mayer had indicated the perspective effect which would be shown in the proper motions of stars by the movement of the sun in space, but had failed to find it. In 1783, from the proper motions of seven bright stars given by Lalande, Herschel determined that the sun was moving in the direction of λ Herculis. From a larger number of stars he obtained a slightly different and not quite so good a direction, as that found by later researches from thousands of stars arranged in all manner of ways according to magnitude, size of proper motion, and type of spectrum.

Herschel's ideas about the physical nature of the sun now seem to us very extraordinary. He regarded it as a dark, cool, solid globe, possibly inhabited, protected by a layer of cloud from the light and heat of the upper luminous region. This solid part of the sun is revealed in the openings of the luminous region shown in sun-spots. This theory held the field for many years. Erroneous facts are harmful, but erroneous theories are better than none at all and act as incentives to better ones.

With his large telescopes, Herschel examined the planets. He discovered two satellites revolving

around 'Georgium Sidus' or Uranus, and thus encouraged found two additional satellites of Saturn. He found that Venus was covered with clouds, noticed the changes in the white spots at the poles of Mars, and concluded that Mars was most like the earth as regards habitability. He determined the direction of the axes, periods of revolution and oblateness of the planets. He found that a spot in the atmosphere of Jupiter had a different period of revolution from the rest of the planet.

Herschel's name is inseparably associated with great telescopes, but for the years 1795–97 he interrupted his work to arrange the stars in different constellations, according to their magnitudes. This was largely done with the naked eye. The work was not estimated at its full value until Prof. E. C. Pickering reduced and discussed the observations. "Herschel furnished observations of nearly 3,000 stars from which their magnitudes a hundred years ago can be determined with an accuracy approaching that of the best modern catalogues".

Herschel was attracted by Messier's short list of nebulæ and clusters published in the *Connaissance des Temps* for 1783. In the belief that all nebulæ could be resolved into stars, he commenced a survey of the whole sky with his new 20-foot reflector of 18 inches aperture. At the same time, by counting the number of stars in equal areas in different parts of the sky, he purposed to 'gauge' the depth of the sidereal universe. He began these famous 'sweeps' of the heavens on October 28, 1783. He first placed his telescope in the meridian, and standing in a gallery at the end of the telescope could give it a motion in azimuth of 10° or 12° either way. He moved the telescope slowly backwards or forwards and noted what he saw. He then changed the telescope 8′ or 10′ in altitude. Twenty or thirty of such operations he called a 'sweep'. They were very fatiguing and spoiled the sensitiveness of his eye for faint objects. After the forty-first sweep he discarded this method and had recourse to vertical sweeps, employing a workman to move the telescope, and calling out his observations to his sister Caroline, who noted them down. In 1789 he published a catalogue of 1,000 clusters and nebulæ. "As a mere explorer of the heavens," wrote Agnes Clerke, "his labours were prodigious. He discovered no less than 2,500 Nebulæ, 806 double stars, and passed the whole firmament in review four several times, and counted the stars in 3,400 *gauge* fields."

In these 'gauges', Herschel counted the number of stars in the field of view of his eyepiece, which had a diameter of 15′. His telescope revealed all the stars to about the fourteenth magnitude, at least a thousand times as faint as the faintest star visible to the naked eye. He found that the number of stars diminished with increasing distance from the Milky Way until they were only one thirtieth of the number at its pole. He was thus led to the 'grindstone' theory of the 'Construction of the Universe'. His views were modified in his later papers in 1811 and 1814 and he realized that the Milky Way is more complex, and that nebulæ are not always irresolvable clusters. "We may have surmized nebulæ to be no other than clusters of stars disguised by their very great distance, but a longer experience and better acquaintance of their nature will not allow of such a principle." He gave the name "planetary nebulæ" to bodies "which, notwithstanding their planetary aspect, retain a haziness by which they are surrounded and evinces their nebulous origin." He regarded the Orion nebula as true nebulosity and typical of other extended nebulæ, but retained his belief that some nebulæ were resolvable into stars and were comparable in size with our own Galaxy.

Only the briefest reference can be made to an important paper published in 1800, when he discovered that "the heat derived immediately from the sun or from candescent terrestrial substances, is occasioned by rays emanating from them; and that such heat-making rays are subject to reflexion and refraction". He gives in a diagram the intensity of the heat in what we should now call all wave-lengths extending from the infra-red to the violet.

We must on no account overlook the help Herschel received all his life from his devoted sister Caroline. From 1772 she was his constant companion, housekeeper and assistant in his music and astronomy. She accompanied him to Slough and would sit up whole nights taking down his observations and copying them out the following day. When William married she took lodgings in Slough and still continued as his assistant. At her brother's suggestion, she searched for comets and discovered no fewer than eight. After Herschel's death she returned to Hanover and prepared a catalogue of 2,500 nebulæ and clusters discovered by him. For this she was awarded the Gold Medal of the Astronomical Society. She died in 1848 after a prolonged and cheery old age.

On May 8, 1788, Herschel married Mary, daughter of Mr. Adee Baldwin, a merchant of the City of London, and widow of John Pitt, Esq. Their son John was born on March 7, 1792. Mrs. Herschel was of an amiable and gentle character and lived on friendly terms with Caroline, whom she had displaced. In 1791, Herschel visited Glasgow and was given the freedom of the City and a doctorate of laws by the University, and

on his return called on Michell, an astronomer of distinction and originality. In 1802 he went to Paris and met Messier, Delambre, Laplace, Count Rumford and Napoleon. In 1816 he was knighted by the Prince Regent. In 1820, when the Astronomical Society was founded, he was made its first president. He was too feeble to attend the meetings, but allowed his last paper to be published in the Memoirs of the Society. He died at Slough on August 25, 1822, and was buried in the Church of St. Lawrence at Upton.*

* In the preparation of this article, I have used to a great extent the admirable introduction to "The Scientific papers of Sir William Herschel" written by Dr. Dreyer, and am also indebted to a conversation with Dr. W. H. Steavenson.—F. W. D.

Obituary Notices

Sir Robert Mond, F.R.S.

ROBERT LUDWIG MOND, the elder son of the late Dr. Ludwig Mond, F.R.S., was born at Farnworth, near Widnes, Lancashire, on September 9, 1867, and was brother of Alfred Moritz Mond, the late Lord Melchett. He was educated at Cheltenham and at Peterhouse, Cambridge. Later he worked at the Polytechnicum, Zurich, and at the Universities of Edinburgh and Glasgow, and had the privilege of being private assistant to Sir William Thomson (Lord Kelvin). His first wife, the mother of his two daughters, died tragically in Egypt in 1905; and he married in 1922 Marie Louise Le Manach, of Belle Isle en Terre, Brittany.

In consequence of his varied training in the physical sciences and the atmosphere of his home, Robert Mond had an extraordinary wide outlook on scientific problems; so that, while never becoming a specialist in any one branch, he was able to contribute materially to the solution of problems in these subjects. On proceeding to Winnington, he had the privilege of working not only with his father but also with such distinguished collaborators as Carl Langer and Friedrich Quincke. He assisted in the investigations leading to improvements in the production of zinc by the electrolysis of zinc chloride, and to the discovery of nickel carbonyl, the basis of the process for the production of pure nickel. In the course of time, Robert Mond was called upon to assume positions of responsibility in various organizations arising from the exploitation of scientific investigations at Winnington. He joined the board of directors of Brunner, Mond and Company and the Mond Nickel Company, of which he subsequently became chairman.

In connexion with the exploitation of the nickel mines at Sudbury, Ontario, Robert Mond identified himself with the Royal Ontario Museum, Toronto, of which he became trustee and to which he gave considerable sums of money and also enriched by valuable contributions arising from his archæological investigations in Egypt. His absorbing interest in archæology dates from about 1898, when, shortly after his marriage, he had to spend winters out of England for health reasons. In his earlier days, Robert Mond was a keen mountaineer, and later, although never of sound physique, his unusual vitality made it possible for him to undergo physical strain which always surprised those who knew him intimately.

In 1910, Robert Mond went to live at Combe Bank, Sevenoaks—one of the first houses to have electric lighting installed—with its model farm and laboratories originally intended for his father's use. Characteristically and with his usual vigour, Robert Mond took up, for him, new investigations in agriculture, including stock-breeding, and it was from here that he supplied with milk the Infants Hospital in Vincent Square founded as a memorial to his late wife. The late Prof. H. E. Armstrong used to maintain that Robert Mond was the first to appreciate the meaning of 'pure' milk and to conduct his experiments on a satisfactory scale.

It is difficult to give an adequate account of Robert Mond's scientific and industrial interests. His scientific greatness lay not so much in what he himself discovered or achieved but in what he did to make it possible for those to achieve who were less fortunately placed. Especially after his father's death, he regarded his wealth and position as a trust to be used in the advancement of knowledge and appreciation of beauty, and through that of international peace and fellowship, and he worked incessantly to achieve this ideal.

The large number and extent of Robert Mond's benefactions will probably never be known to the outside world, and if by chance he happened to mention any one of them to an intimate friend one felt that he had been guided by his ideals rather than by the mere amelioration of a difficult financial situation. Some of them in Great Britain are known. There is his large benefaction to the University of Liverpool, of which he held the honorary LL.D. degree. Another typical example of what he has done for the advancement of scientific knowledge is his work for the Royal Institution. Sir Robert Robertson, the honorary treasurer, has written:

"By the same deed of trust (1896) of Ludwig Mond in which he conveyed the Davy-Faraday Research Laboratory and its endowment to the Royal Institution, Robert Ludwig Mond was named Honorary Secretary of the Laboratory Committee for life. When in London he came occasionally to the meetings of the Committee and read the minutes. To the equipment and furnishing of the Davy-Faraday Laboratory, he gave much thought and travelled over the Continent and in America studying arrange-

ments of laboratories and purchasing apparatus for his father's foundation. Although forty years have passed since the laboratory was fitted up according to his designs, the arrangements of benches and of electrical distribution are still in use. At the celebration of the centenary of Faraday's discovery of electricity from moving magnetism (1931), he represented the Faraday Society and gave £5,000 towards the reconstruction of the theatre. His interest in the Davy-Faraday Laboratory continued unabated and recently he gave £2,000 to its funds. He also caused to be collected and printed a list of workers in the laboratory from 1896 to 1932 with their publications. The Royal Institution has lost a good friend."

It is interesting to note that Robert Mond's knowledge of the Royal Institution and the unique place it occupies as a scientific centre guided him to a large extent in what he did later in Paris. Much more recently, he gave a sum corresponding to the amount he gave to the Maison de la Chimie in Paris to the funds of the National Council for Chemistry. Like his father, keenly interested in the documentation of scientific knowledge, he hoped that this might be a nucleus from which the more satisfactory documentation of chemical literature and, possibly, a British 'House for Chemistry' might arise.

In celestial chemistry, and other related branches of astronomical research, Robert Mond also took keen interest and encouraged in many ways. He was one of the seven original subscribers to the Hill Observatory Corporation, registered in 1916 to establish an observatory at Salcombe Regis, Sidmouth, Devon, the name being changed in 1921 to the Norman Lockyer Observatory, in memory of the distinguished astronomer who founded it. He became chairman of the corporation twenty-one years ago and occupied that position when he died. Since its foundation, the Observatory has been equipped and maintained entirely by private donations, and Robert Mond was one of its chief benefactors. Six years ago, he generously presented to the Observatory a completely new form of photographic equatorial telescope, which he termed an 'astronomical robot' for the photography of extensive celestial fields with long exposures and on different scales.

In recent years, Robert Mond became as much at home in France as in Great Britain. This was partly a result of his ardent desire to improve international understanding among scientists generally and chemists in particular. In France, he was a generous benefactor of the British Institute in Paris, and he worked wholeheartedly for the France-Grande Bretagne Association. Our French colleagues realized his unique qualities and honoured him (and us) by electing him president of the Société de Chimie industrielle, an office which he held at the time of his death.

The founding in Paris of the Maison de la Chimie as a memorial to Marcelin Berthelot appealed to Robert Mond intensely: in his own words, "L'idéal que matérialisent ces bâtiments a permis de créer mieux qu'une maison : un état d'esprit international. Et c'est cette foi commune qui, loin des luttes de la politique, cherche à élever toujours plus haut les manifestations de l'intelligence scientifique et le rayonnement du génie humain." He became Membre du Conseil d'Administration de la Maison de la Chimie and, apart from contributing 1,000,000 francs to its funds and, in order that its future and development might be secured, he founded and became president of the Société des Amis de la Maison de la Chimie. What he did for the Maison de la Chimie was typical of many other benefactions in France, all carried out in the spirit of furthering the accomplishment of his ideals. France fully recognized the high quality of his efforts, and none of his friends were surprised at his promotion from 'Officier' to 'Commandeur' de la Légion d'Honneur. In 1937, he was elected Membre de l'Académie des Inscriptions et des Lettres, becoming Membre de l'Institut de France.

Robert Mond received the order of knighthood in 1932. Of his election this year to the fellowship of the Royal Society, he was immensely proud. His letter to the present writer contained the following sentence: "To be considered worthy of admission to the same distinguished Society which recognised my father is the greatest honour I could receive." Arrangements had been completed for conferring on him, by the University of London, the rare distinction of the honorary D.Sc. degree.

Robert Mond's interests in human knowledge and progress were so wide that it is difficult to realize how he found time and strength to maintain them. Recently he suffered considerable physical disability, but his amazing spirit and the constant care of Lady Mond carried him through. In spite of ill-health, he never hesitated to accept an office to which arduous duties were attached when he believed that thereby he might contribute to the realization of his ideals. The international character of the meetings of the Faraday Society was a deciding factor in accepting its presidency, and his interest in photography and especially in colour photography from his early days led him to accept the honorary treasurership of the building appeal (now in progress) of the Royal Photographic Society.

Robert Mond died at his Paris residence on October 22. All who knew him and enjoyed his friendship will warmly endorse the sentiments so ably expressed at the funeral by Prof. Auguste Béhal and Louis Hauzeur. The ashes are interred at Belle Isle en Terre. To Lady Mond and to the family we can only express our deepest sympathy and feel proud that we have been privileged to know a great man who described himself as "un serviteur modeste mais dévoué de la Science". CHARLES S. GIBSON.

IN the passing of Sir Robert Mond, Egyptology has lost one of its most generous supporters, as well as a most devoted student. Ever ready to help in financing explorations in the field, he himself took the keenest pleasure in the actual work of excavating and enjoyed nothing better than being at the bottom of a tomb-shaft, sifting the sand with his own hands in the hope of finding some hidden treasure.

It was my privilege to meet Mond first at his father's house in London in 1896, and when he

visited Egypt a few years later, he came to me at Thebes and expressed the wish to collaborate in the exploration of the Mortuary Chapels of the Nobles which I was then carrying out on a very small scale in the Theban necropolis. In 1902, when I relinquished this work in consequence of other duties, Mond took over the concession which I then held from the Egyptian Government, and early in 1903 began working the concession himself. This work he continued for the next three winters and published his reports in the *Annales du Service des Antiquités*, then being edited by Prof. Maspero. Later, when he was prevented from personally supervising the excavations, Messrs. Howard Carter and Arthur Weigall, the successive inspectors of antiquities in Upper Egypt, continued the task with the financial aid of Mond and others. In 1909 he sent out from England Mr. Jelf, an Oxford graduate, to assist Weigall. In 1913 was published the "Topographical Catalogue of the Theban Tombs" by Dr. Alan Gardiner and Weigall, with the assistance of Mond, which is a record of what had, up to then, been accomplished. In the introduction to this book, Gardiner wrote that it was due "in large part to the personal endeavours and enlightened liberality of Mr. Robert Mond that the Theban Necropolis is now, on the whole, well protected and in a satisfactory condition".

Mond now set himself whole-heartedly to work out a well-considered and continuous scheme of restoration and preservation of the Theban tombs. In a lecture which he delivered before the Royal Institution in May 1914, he told his audience that "this object, which had been one of my day-dreams for many years, took shape when the opportunity arose which enabled me to secure, after many consultations with the most competent Egyptologists, and especially with Dr. Alan Gardiner, the services of Mr. Ernest Mackay, for many years the chief assistant of Prof. Flinders Petrie", and he announced that Mackay "will now devote his whole time to the systematic inspection, excavation, restoration, and preservation of these chapels". But Mackay had been employed only a little more than a year when the Great War broke out, and soon afterwards the work at Thebes had to be abandoned.

It was not until the winter of 1923 that Mond again began explorations at Thebes, when he employed Mr. Yeivin in the autumn of that year to superintend the excavations. The same year Mr. Walter Emery, a student of the late Prof. Peet at the University of Liverpool, was sent out to Egypt, and in 1924 took charge of the work. Mond's work was now carried out in association with, and under the ægis of, the University of Liverpool Institute of Archæology, an institution that he had long been interested in, having joined the Committee in 1910. On going over the necropolis with Emery, it was decided to clear and restore the famous tomb of Ramose, vizier of Amenhetep III and Akhenaton. This took three winters to complete, and the publication of the scenes and inscriptions in it has been entrusted to the skilled hands of Mr. Norman de Garis Davies, of Oxford, and for many years on the staff of the Metropolitan Museum of Art, New York. Mond's and Emery's reports for the years 1923 to 1926 are printed in the *Liverpool Annals of Archæology and Anthropology*.

In the spring of 1926, Mond and Emery prospected on a new site at Armant, the ancient Hermonthis, ten miles up river from Thebes. A concession covering about fifty square miles was applied for in the name of the Liverpool Institute of Archæology, and when this was granted, Mond began excavating there. The burial ground of the Buchis Bulls, sacred animals famous in Egyptian history, was soon discovered. Mond then had a motor road, some ten miles long, cleared from Thebes to Armant to enable him to visit Emery two or three times a week to inspect the work and record progress. In 1928 the Armant concession was transferred to the Egypt Exploration Society, of which Mond had been elected president on the death of General Sir John Maxwell. A large staff was sent out under the direction of Dr. Frankfort, Mond bearing the whole expense. In the following year Frankfort resigned on being appointed field director of the Iraq Expedition of the Oriental Institute of the University of Chicago, and the Armant excavations were supervised for a season by Mr. F. W. Green, of the Fitzwilliam Museum, Cambridge, Emery having been appointed by the Egyptian Government to carry out the Nubian Archæological Survey. Then Mr. Oliver Myers was appointed director, a position he has held ever since.

How ably this work has been carried out is evidenced by the three volumes published in 1934, entitled "The Bucheum", by Sir Robert Mond and Oliver Myers, and by two volumes issued last year on "The Cemeteries of Armant" by the same authors. To these books no fewer than sixty-nine scholars and scientific workers have contributed, among them many bearing distinguished names. It is interesting to note that two Egyptians have written chapters: one, G. Mattha, a student of the late Prof. Griffith, writes on Demotic Ostraca; the other, Suliman Huzayyin, contributes an able paper on "The Flint Industry". These volumes show how wide was Mond's outlook in Egyptology and how catholic were his interests. Although much more remains to be published of the work he was engaged on, it is pleasant to know that he lived to see these five volumes distributed. During the last two years, Mond also financed the work of Dr. Hans Winkler in the Eastern and Libyan deserts; a small volume, "Völker und Völkerbewegungen im vorgeschichtlichen Oberägypten im Lichte neuer Felsbilderfunde", was issued last year, and "Rock-drawings of Southern Upper Egypt", by the same writer, has just appeared.

Before concluding this notice of Sir Robert Mond's Egyptological activities, as an example of his keenness in the preservation and provision for the careful publication of antiquities, may be mentioned his acquisition of a unique series of papyri. When we were at Thebes in the spring of 1904, we heard that native diggers had made a 'find' of 'Hebrew' papyri at Elephantine. Mond at once telegraphed to the dealer who had secured the documents, asking that they should be kept for his inspection. Next morning, he set off for Aswân and at once bought the papyri with the intention of presenting them to the British

Museum. But the Service des Antiquités, hearing of the purchase, requested Mond to sell the documents to the Cairo Museum. Recognizing that this was really a command, he at once presented the collection to the Cairo Museum authorities on condition that he should have the right of publication. He then commissioned Prof. Sayce and Dr. Cowley, of Oxford, to edit and translate the documents, and in 1906 was published the splendid volume "Aramaic Papyri discovered at Assuan". This was due entirely to Mond's munificence. Mond possessed a collection of antiquities at his home in Cavendish Square, but it was his invariable habit to give the best pieces he bought to museums, rather than keep them himself. He was the first to contribute on a munificent scale toward the purchase of the important Petrie Collection of Egyptian Antiquities for the University of London, and the Toronto Museum has benefited greatly by his gifts.

Percy E. Newberry.

We regret to announce the following deaths:

Mr. H. G. Billson, C.I.E., formerly chief conservator of Indian forests, on October 27.

Paul Helbronner, 'free member' of the Paris Academy of Sciences, who made a geodesic survey of the French Alps from Lake Geneva to the Mediterranean, and later extended the network to Corsica, on October 18, aged sixty-seven years.

Dr. Volkmar Kohlschütter, professor of inorganic and physical chemistry in the University of Bern, on September 10, aged sixty-five years.

Prof. P. A. Murphy, professor of plant pathology in the Albert Agricultural College, University College, Dublin, on September 27, aged fifty-one years.

Prof. Georges Urbain, professor of chemistry in the Sorbonne, on November 6, aged sixty-six years.

Miss Clotilde von Wyss, formerly lecturer in natural history in the Institute of Education (University of London), on November 7.

News and Views

Royal Society Awards

The following awards of medals have been made by the president and council of the Royal Society: Copley Medal to Prof. Niels Bohr, For. Mem. R.S., in recognition of his distinguished work in theoretical physics and particularly in the development of the quantum theory of atomic structure; Rumford Medal to Prof. R. W. Wood, For. Mem. R.S., in recognition of his distinguished work and discoveries in many branches of physical optics; Davy Medal to Prof. G. Barger, F.R.S., in recognition of his distinguished researches on alkaloids and other natural products; Darwin Medal to Prof. F. O. Bower, F.R.S., in recognition of his work of acknowledged distinction in the field in which Darwin himself laboured; Hughes Medal, awarded jointly to Dr. J. D. Cockcroft, F.R.S., and Dr. E. T. S. Walton, in recognition of their discovery that nuclei could be disintegrated by artificially produced bombarding particles.

Lord Lugard, G.C.M.G.

A bronze statuette of Lord Lugard has been presented to the Imperial Institute by members of the Royal African Society as an addition to the collection of statuettes of empire-builders in the Institute's galleries. The presentation took place on November 7, when the statuette, which stands in the Nigerian Court, was unveiled by the Earl of Athlone, president of the Society, and formally accepted by Sir Harry Lindsay, director of the Institute. The statuette, which is half life-size, is the work of Mr. Herbert H. Cawood, who has executed the effigies of Cabot, Van Riebeck, Raffles, and Livingstone in the collection. Lord Lugard is the only living subject represented. The presentation marks the fiftieth year since Lord Lugard's first service in Africa. His brilliant success as an administrator of native affairs has been due to his application of the policy now known as 'indirect rule' to tribal government, in order to secure maintenance of law and order through the least disturbance of tradition by the imposition of civilized authority. His book, "The Dual Mandate in British Tropical Africa" (1922), not only gained him the award of the Gold Medal of the Royal Geographical Society, but immediately became a classic, as Lord Athlone said in his address of presentation, when he also spoke of Lord Lugard as "the father of indirect rule". Owing to his advocacy and the practical demonstration of its efficiency in Nigeria, the principle of 'indirect rule', with or without modification, has been extended to the other British colonial possessions in Africa. In 1922–36 Lord Lugard was the British representative on the Permanent Mandate Commission of the League of Nations; while as Chairman of the Council of the International Institute of African Languages and Cultures, he has inspired and guided a great work of scientific research on the peoples and languages of Africa.

Miss Lise Meitner

Many readers of Nature will wish to join with her friends in offering their congratulations to Miss Lise Meitner on the occasion of her sixtieth birthday, which she celebrated in Stockholm on November 7. It is now more than thirty years since Miss Meitner left Vienna for Berlin to begin work on radioactivity with Prof. Hahn, and throughout the whole of that period, both alone and in collaboration, she has contributed as much almost as any one person to the subject to which she devoted all her energies. During the years 1908–10, in collaboration with Hahn, she studied in detail the radiations from the active deposits of radium, thorium and actinium, obtaining

the first indications of the existence of the C″ bodies and of the radiations from radium D. Between 1911 and 1915, with v. Baeyer and Hahn, she studied the groups of β-particles by the direct deviation method, showing that α-ray as well as β-ray bodies give rise to such groups. After the Great War, Miss Meitner turned to the semicircular focusing method for the further study of the β-ray groups, regarding them now as secondary radiations associated with γ-ray emission, and was the first to maintain that in the process of disintegration the emission of radiation follows, rather than precedes, the emission of the particle. Experiments on the long range α-particles, with Freitag, on the heating effect of the β-particles of radium E, with Orthmann, and on the scattering of hard γ-rays, in collaboration with Hupfeld, occupied the years 1926–32. Since 1932 Miss Meitner has devoted her attention more and more to studies of nuclear transmutation and artificial radioactivity. With Hahn and Strassmann she has investigated particularly the complicated series of bodies obtained by bombarding uranium and thorium with neutrons.

R.A.F. Long-distance Non-stop Record Flight

Three R.A.F. Vickers Wellesley bombers, two of which landed at Darwin, Northern Australia, at 4 a.m. (G.M.T.) on November 7, have broken the world's long-distance record, held by the Russian airmen who flew from Moscow to San Jacinto (California), a distance of 6,306 miles. The two Vickers machines covered a distance of 7,162 miles non-stop, from Ismailia to Darwin, while the third was forced to land at Koepang, Timor, 400 miles short of this, owing to lack of fuel. It afterwards completed the journey, arriving at Darwin at 7.36 a.m. Their speed averaged about 149 miles per hour, as compared with 102 miles per hour for the Russian record. The actual machines and their crews are a flight known as the Long Range Development Unit of the R.A.F., under the command of Wing-Commander Gayford, specially charged with the duties of investigating service problems associated with long-distance flying. Early in the flight, they flew in formation under the command of Squadron-Leader Kellett, but later they separated, the other two machines under Flight-Lieutenants Hogan and Combe each flying independently.

The aircraft are standard Vickers Wellesleys as supplied as bombers to R.A.F. squadrons, modified for very long distance flights, principally having greater fuel tank capacity. They are cantilever monoplanes built with Vickers geodetic method of construction. The exceptional lightness of this structure allows a correspondingly large weight of fuel to be carried within the limitation of their maximum weight. They are fitted with retractable undercarriages, totally enclosed cabins and all other devices for reducing their drag to a minimum, thus keeping the power required as small as possible. The Bristol Pegasus XXII engine with its very low fuel consumption, adding to these refinements, has given the combination that makes a flight of this length possible. The machines were fitted with automatic pilots, which relieve the pilots of much of the necessity for actually holding the controls on a long fixed course. Sleeping accommodation was arranged in the cabins, and the other two members of each crew, navigator and wireless operator, were qualified pilots, able to control the aircraft when required.

Planning for Defence

A broadsheet issued by PEP (Political and Economic Planning) entitled "Planning for Defence" directs attention to the necessity for fundamental thinking as to the values upon which the society that is being planned is to be based. The dangers of running a world by standards which are largely distorted for immediate material ends is clearly revealed by the events of September last, and realization of these dangers may well compel a reassessment of values, checking the drift towards opportunist materialism, and the evolution of a more explicit code of values on which the democracies and people in all countries who are not prepared to succumb to temporary illusions can take their stand as a basis for working towards a more tolerable human society. Simultaneously, specific thinking about the problems of a society and economy functioning under the shadow of war is urgently demanded and reinforces the case for eliminating waste in distributive services and elsewhere, the conservation of national resources, the adoption of economic operating units for public services and the rationalization or decentralization of some of the local government services or functions and staffs concentrated in London.

The broadsheet suggests that such adjustment must be based on three principles: maximum efficiency (which in wartime might not coincide with efficiency in peace); the maintenance or even extension of ultimate democratic control, particularly in the economic sphere, whatever special powers might be needed; and the framing of emergency measures so far as possible in accord with the long-term needs of social and economic reconstruction. The importance of local self-reliance is stressed, for an educated democracy requires both resolute leadership and information on which to base its judgment and actions. It will be necessary to think out very carefully the respective functions of the local committee or council, of the executive officers who perform the local service and of the officer who represents the requirements of the central government. While the central government would require decentralization, many local services require larger operating areas for efficiency. The broadsheet further refers to the need for public information, for rationalizing transport and distribution, for keeping a balance between demands and the normal economic life of the community. The structure of industry and especially the location of new plant present special problems, and, in regard to man power, one of the most serious problems is that of utilizing professional and technical workers. Nutrition policy and food control, land policy, the acquisition of development rights are other questions to which the broadsheet briefly directs attention.

Protection against Propaganda

Science Service of Washington, D.C., has published under the title "Propaganda Protection" a series of short articles forming an exposition of the methods and aims of war propaganda. The chemist and physicist are frequently criticized for discovering poison gases and high explosives, but without the will of the fighter the destructive compounds would be powerless. The aim of the propagandist is to make people willing to act in a particular way, and his general means are the arousal of emotion and the stifling of reason. The specific methods are the appeal to prejudice and hate by the use of slogans, by the demand for haste since delay may bring reason into play, by the use of statements that can neither be proved nor disproved, by concealing the source of the statements, and by persuading the hearer or reader to associate particular evils, for example, conspiracy, plotting, oppression, injustice, and particular virtues, for example, bravery, sympathy, humanity, patriotism, with some particular creed, party, or country. The propagandist knows the weaknesses of mankind and in many cases consciously exploits them for his own ends. The general methods are not new in the history of mankind, but the development of the means of communication by travel and radio has made all of us much more vulnerable to the propagandist attack. It is commonly asserted that more knowledge is the best immunizing agent against propaganda; but to be effective we need much more knowledge of our own mental make-up, as well as greater knowledge of facts outside ourselves. It is unfortunate that our knowledge of psychology lags so far behind our knowledge of other aspects of reality.

Physical and Mental Welfare Society of New Zealand

On July 22 last, a body known as the Physical and Mental Welfare Society of New Zealand was formally incorporated; the object of the Society is, broadly, to promote the application of current scientific knowledge to physical and mental welfare. The Society originated in a movement which has existed and operated throughout the Dominion for several years. It was promoted by a group of voluntary workers in the social services, under the leadership of Mrs. Ysabel Daldy, who has hitherto worked under the *noms de plume* of "Mother Machree" and "Silent Peter". In numerous weekly articles contributed to some twenty New Zealand newspapers, she has interpreted current scientific knowledge in its bearings on social welfare to the general reader in simple and attractive language, thus moulding public opinion and preparing the way for necessary reforms. She has been assisted by the "Silent Peter" group of specialist advisers, which is stated to include representatives of the medical profession and others well qualified severally to advise and write on health, nutrition, agriculture, education and some branches of science. Through her articles in newspapers and by correspondence with Government departments and with individuals, Mrs. Daldy has done valuable work in guiding and stimulating public opinion, and the increased opportunities afforded by the new Society of reaching the public by lectures, publications and other means, should enable this body of scientific opinion to exert its full influence in promoting the application of science to social problems in New Zealand.

Archæological Investigations in the Hadramaut

Further details of archæological investigations in the Hadramaut of southern Arabia were given by Miss G. Caton-Thompson in a lecture before the Royal Geographical Society on November 7, in which she described the results of the expedition undertaken by Miss Elinor W. Gardner, Miss Freya Stark and herself in the winter of 1937–38. The uniform, but crude character of the palæolithic industry of the region, to which she referred in her preliminary report (see Nature, **142**, 139, July 23, 1938) was again emphasized. This industry falls well within the limits of the Levallois flake industry; but its crudity is strikingly apparent on comparison with the corresponding industries of Africa, North Arabia and Palestine. It represents a low ebb in contemporary standards, which Miss Caton-Thompson is inclined to attribute either to the influence of a harsh and impoverished environment, or possibly to the absence of technical stimulus from contact with more progressive groups, such as, for example, might have been supplied from East Africa. The latter alternative postulates the separation at an early date in the Pleistocene or before of south-west Arabia from East Africa. The conception of an early marine separation of the two regions is reinforced by the fact that of the three culture groups classified morphologically by the hand-axe, the flake, and the blade industries, the hand-axe culture group, which covers practically the whole of Africa, failed, so far as the evidence goes, to reach south-west Arabia. The huge numbers of flint implements of Levallois type argues a *status quo* so far back as the middle or later Pleistocene. Of the evidence of plant life found in the tufa in the Wadi Luqrun, absence of structure makes identification impossible; but one is a species of *Celtis*, another type, the commonest, resembles the fig in leaf; and some kind of palm is certainly present.

The Government Laboratory

Seventeen thousand samples in excess of the number submitted in the previous year are recorded in the report of the Government Chemist as having been examined in the year ended March 31, 1938. The total number was substantially larger than half a million. The work of the Laboratory, however, is not to be measured by numbers alone, for it involves much research into the reliability of existing methods of analysis, and many investigations into new methods of detection and determination of substances. Further, the staff is constantly being consulted on technical matters, while, in addition, its members contribute notably to the advance of pure and applied chemistry both by publication and by personal service

on numerous committees. In its analysis of the results of the examination of 848 samples of imported butter, the report shows that the water content of considerably more than half of the samples was between 15 and 16 per cent; the Reichert value of the fat varied from 24·0 to 34·0 (in 555 cases from 28 to 32), while the Polenské value varied from 1·0 to 3·35. Of 87 samples of tinned cream, 81 contained between 20 and 29 per cent of fat; of 127 samples of cheese, 17 per cent had been prepared from milk containing less than one half of its fat. In neither case is it at present possible to take exception to such importations. The examination of water included sea water studies for the use of hydrographers and biologists, on rivers in connexion with fish and fish food, and on water-cress beds in relation to the use of the national mark. Of 2,270 samples of brewing materials, 18 contained arsenic in slight excess of the accepted limit. It is satisfactory to learn that owing to the stringency of the tobacco laws and the high standard of the tobacco industry in Great Britain, adulteration is almost non-existent. The Laboratory has also been concerned with such widely different matters as the pollution of foreshores, the manipulation of radioactive materials, the carriage of dangerous cargo, and the work of the Bed-bug Infestation Committee.

Carrier Telephony

An instructive address on carrier telephony was delivered to the London Students' Section of the Institution of Electrical Engineers, on October 31, by its chairman, P. H. Pettifor. The frequencies present in the normal speech range are included between the limits 75–9000 cycles per sec., but for intelligible and 'natural' speech, it is only necessary for the listener to hear a very small portion of that spectrum, and in normal telephone practice the range lying between 300 to 2700 cycles per second only is used. This possible restriction in the range necessary for satisfactory speech is fully utilized in carrier telephony. The lower the frequency of the transmitted band the greater the number of channels which can be accommodated for that band. A carrier-current telephone system is one in which the normal voice frequencies are raised to a band of higher frequencies before being transmitted over the open-wire line or cable, conversion to the normal voice frequency band taking place at the receiving station. If different circuits have their voice frequencies raised by amounts such that the high-frequency bands do not overlap one another, then one cable pair can be used to transmit speech to several circuits, without the circuits interfering with one another. In this way the signals in several circuits can be transmitted over one cable pair without any interference taking place. The development of the principles of carrier telephony has been slow; the early experiments were made by Ruhmer in 1909, before the present-day thermionic devices were developed. A brief description was given of the post-War development in this field, including the latest cable design technique. Amongst the types of cable described was a cable containing a pair of air-spaced self-locating conductors. This type of cable is laid around London for television purposes. Another type containing four coaxial conductors has been laid between London and Birmingham. A similar coaxial cable containing only one coaxial conductor insulated with para-gutta has also been found very useful. With modern systems the level of cross talk between channels is practically negligible when compared with the normal voice frequency systems.

A 'New Deal' in Education

President Roosevelt's Advisory Committee on Education, appointed in September 1936, has presented a report (Government Printing Office, Washington, 1938. Pp. 244. 35 cents) on the whole subject of Federal relationship to State and local conduct of education. After a comprehensive study of the entire field of educational service, the committee found that there is great need for improvement of the public schools in a number of broad geographical regions and in the rural areas generally. To redress the existing gross inequalities of educational opportunity it submits a set of carefully articulated proposals forming, as is justly claimed, "a unified and coherent pattern of Federal policy" and involving a six years plan for Federal grants for educational services amounting in the aggregate to 1,200 million dollars. Most of the new grants recommended fall under the headings: general aid to elementary and secondary education, preparation of teachers and other educational personnel, school buildings, administration of State departments of education, educational services for adults, library service for rural areas. A system of co-operative research accompanied by demonstration projects throughout the country has proved its value in the field of agriculture, and the committee recommends the establishment of a special Federal fund for the immediate application of such a system in the field of education. In the first instance it would be utilized especially for elucidating in advance problems bound to arise in connexion with the operation of the six years plan for Federal grants.

The Colombo Museum

The administration report for 1937 of the acting director of the Colombo Museum, P. E. P. Deraniyagala, shows that in many directions the activity of the museum is maintained. Steady additions are being made to the zoological collections, notably by expeditions carried out by the staff or by the staff jointly with representatives of the British Museum, so that the director considers that the accumulation of material is now sufficient to justify the publication of detailed monographs. At the same time, attention ought to be directed to the public galleries, and the replacement of the misleading and faded specimens in the bird gallery would doubtless be appreciated by the half-million visitors who pass through the galleries each year and especially by the large number of school-children (12,288) who make use of the exhibits in the course of their nature study instruction.

A suggestion that the collection of living animals should be transferred to the Government Zoological Gardens at Dehiwala was strenuously opposed by the Committee of Management, and instead efforts are being made to improve and extend this museum zoo, which is an invaluable educational adjunct to the mounted collections. The Ethnological Department has begun a survey of the native population, and various expeditions have been carried out for a study of cultural institutions and social and economic conditions.

Trachoma in Tunisia

In a recent study (*Thèse de Paris*, 1938, No. 142), Dr. C. Koskas states that trachoma was probably imported into Tunisia by immigrants from North Africa, Italy, Malta and Spain. Although it is a notifiable disease, the natives, who do not recognize the gravity of the condition, evade the law, and comparatively few cases are actually notified. The only means of determining in any way the frequency of the disease is by medical examination of school children or of recruits for the army. There is no doubt, however, that infection rarely occurs in adults or in the schools; but that it is usually contracted in the early months of life. The incidence of the disease is much higher in the south where the climate is hot, the sirocco violent and frequent, the atmosphere laden with dust and sand, and the inhabitants poverty stricken and underfed than in the north of Tunisia. Flies play an important part in the transmission of the disease, as was shown by Nicolle and Cuenod in 1921, Petit in 1925 and Mme. Delanoe in 1930; but race does not influence the incidence or gravity of the disease. Good work has been done by the establishment of ophthalmic departments where free advice and treatment are given.

Electrical and Allied Manufacturers' Association

The eleventh edition of a pamphlet giving information about the British Electrical and Allied Manufacturers' Association (Beama) has just been published. The president of the Association is the Earl of Derby. The objects of the Association are to foster and protect the electrical and allied industries in Great Britain. It aims at securing the co-operation of every firm in the electrical and allied industries so that, by co-operative action, it can speak for the whole of those industries on all matters affecting them. The Standardization Committee acts as a centre and clearing house for the many activities of its members in connexion with standardization and the British Standards Institution. The Association's numerous technical and other committees are continuously at work in the interests of the sections by which they are appointed and of the members generally. The address of the Association is 36 Kingsway, W.C.2.

Earthquake in Bulgaria on November 6

At approximately 21 h. G.C.T., an earthquake damaged property and felled chimneys in the Gabrovo district in north Bulgaria. Many people were alarmed, but no loss of life is reported. Bulgaria as a whole must be considered an earthquake country, though the north has not been subjected to so many as the south. The chief epicentral region in north Bulgaria is around Tirnovo, and the next in importance is the Déli-Orman. Further information concerning the shock will probably come shortly from Dr. K. T. Kiroff and his colleagues at the observatory at Sofia.

Japanese Earthquake of November 5

An earthquake was experienced in the Miyagi Prefecture in the north-east of the main island of Japan at 8 h. 44 m. G.C.T. (5.44 p.m. local time), and an after-shock followed two hours later. The focus appears to have been at some considerable depth, as the shock was felt in the four Prefectures of Miyagi, Iwate, Fukushima and Ibaragi, and even as far as Tokyo, though no damage is reported from this city. In this part of Japan there is a well-defined belt of earthquake epicentres stretching from Kamagata through Wakamatsu and Utsunomiya to Choshi. Severe earthquakes happened in the north end of this belt in 1893, 1894 and 1895, the last two from the same epicentre, though more recently strong earthquakes have been more frequent along parallel belts to the south, west, north, and seaward of this. The shock which was recorded on seismographs at Kew and elsewhere in Great Britain at 8 h. 55 m. 59 s. G.C.T. and mentioned in the general press in connexion with the above, was not due to the Japanese earthquake but was from some epicentre at about 87° from Kew, though the exact location is not yet determined.

Commonwealth Fund Fellowships

The total number of Commonwealth Fund Fellowships offered for award in 1939 is thirty-four. These fellowships are tenable at certain American universities. Candidates for Ordinary Fellowships must be of British descent who are domiciled in the United Kingdom of Great Britain and Northern Ireland, and are degree graduates of recognized universities therein. Candidates for Dominion Fellowships must be of British descent from the British Dominions, who have studied, but not necessarily graduated, at a university in the United Kingdom of Great Britain and Northern Ireland, who are degree graduates of a recognized university in a British Dominion or Colony. Candidates for Service Fellowships must be of British descent and must hold appointments overseas under the British Government, or the Government of India, or the Government of a British Dominion, Colony, Protectorate or Mandated Territory; and those for Home Civil Service Fellowships must be holding appointments in the Home Civil Service. None of these fellowships is open to women. Further information can be obtained from the Secretary to the Committee, Commonwealth Fund Fellowships, 35 Portman Square, London, W.1.

International Union of Geodesy and Geophysics

The International Union of Geodesy and Geophysics will hold its seventh general assembly in Washington, U.S.A., on September 4–15, 1939.

Invitations have been extended on behalf of the President of the United States to the participating countries to be represented by delegates on this occasion. The American Geophysical Union is the American section of the International Union of Geodesy and Geophysics, and its executive committee is the Committee on Geophysics of the National Research Council. The Council is collaborating with the American Geophysical Union as host to the assembly. The last general assembly of the International Union was held at Edinburgh, Scotland, in September 1936. The thirty-five nations at present adhering to the International Union are: Argentina, Belgium, Brazil, Bulgaria, Canada, Colombia, Chile, Czechoslovakia, Denmark, Egypt, Finland, France, Germany, Great Britain, Greece, Holland, Hungary, Indo-China, Italy, Japan, Morocco, Mexico, New Zealand, Norway, Peru, Poland, Portugal, Rumania, Siam, Spain, Sweden, Switzerland, Union of Soviet Socialist Republics, United States, and Yugoslavia.

Another Large Sunspot

The giant sunspot which crossed the sun's disk between October 5 and 18 broke up before its return, due at the eastern limb on November 2. Meanwhile, another large spot had formed in solar longitude 273° and in latitude 9° south. This spot came round the limb on November 4, though it was not completely seen until the following day, when its area was 2000 millionths of the sun's hemisphere. The time of central meridian passage was November 10·8 U.T.; its date of disappearance around the western limb will be November 17.

Announcements

Dr. W. D. Lang, keeper of the Department of Geology of the British Museum (Natural History), is to retire on December 29. The principal trustees of the Museum have appointed Mr. W. N. Edwards, deputy keeper of the Department, to succeed Dr. Lang. Mr. Edwards was born in 1890 and was a scholar of Christ's College, Cambridge. He entered the British Museum (Natural History) as an assistant in the Department of Geology in 1913 and became deputy keeper in 1931. He is an authority on fossil plants and has travelled extensively.

Dr. T. S. Wheeler, principal of the Royal Institute of Science, Bombay, has left India and will shortly take up his new appointment as State Chemist, Eire.

Mr. J. Wickham Murray, secretary of the Association of Teachers in Technical Institutions, has been appointed an official for higher education by the executive of the National Union of Teachers.

At the anniversary meeting of the Mineralogical Society on November 3, the following were elected officers: *President* and *Editor of the Journal*, Dr. L. J. Spencer; *Vice-Presidents*, Prof. C. E. Tilley and Lieut.-Colonel W. Campbell Smith; *Treasurer*, F. N. Ashcroft; *General Secretary*, G. F. Claringbull; *Foreign Secretary*, Sir Thomas Holland.

A symposium on "Gas Temperature Measurement" will be held by the Institute of Fuel in the lecture theatre of the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, W.C.2, on December 2. It will commence at 10.30. Further information can be obtained from the Secretary, Institute of Fuel, 53 Victoria Street, London, S.W.1.

The Royal Sanitary Institute Congress of 1939 will be held at Scarborough on July 3–8 and the Congress of 1940 at Torquay on July 1–6. Further information can be obtained from the Secretary of the Institute, 90 Buckingham Palace Road, London, S.W.1.

A fourth Farming Conference will be held at Oxford under the joint auspices of the School of Rural Economy, the Agricultural Economics Research Institute and the Institute for Research in Agricultural Engineering of the University of Oxford on January 3–5, 1939. Further information can be obtained from the Conference Secretary, 10 Parks Road, Oxford.

The Far Eastern Association of Tropical Medicine will hold its tenth Congress at Hanoï, Tonkin, on November 24–30, when discussions will be held on feeding in deficiency diseases, cholera, malaria, plague, tuberculosis, venereal disease, surgery, diseases common to man and animals, parasitology and local anthropological characteristics.

The next International Congress of Surgery will be held in 1941 at Stockholm under the presidency of Dr. Leopold Mayer.

The Congress of Comparative Pathology will be held in Rome on May 15–20, 1939, under the presidency of Prof. Rondoni, director of the Cancer Institute at the University of Milan. The following subjects will be discussed: ultra-virus diseases; heredity in pathology; the association of antigens, and their function; regressive processes in plants. The secretary of the Congress is Prof. Zavagli at Consiglio Nazionale delle Ricerche, Piazzale delle Scienze, Rome, from whom further information can be obtained.

The Home Secretary proposes to make regulations under the Factory Act 1937 extending the provisions of Section 66 to compressed air illness. Copies of the draft regulations may be ordered through any bookseller from H.M. Stationery Office.

The Pasteur Institute of Algiers, of which Dr. Edmond Sergent is director, has been authorized by the French Government to sell a serum against scorpions prepared from immunized horses.

Erratum. In Nature, November 5, p. 843, "Origin of the Solar System"; last line of first paragraph, for "internal" read "external".

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 879.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Formation of a New Phosphate Ester in Kidney Extracts

THE phosphorylation of sugars and glycerol in kidney extracts is increased by addition of fumaric or malic acid, and this effect is caused by a stimulation of the tissue respiration[1].

If fumaric or malic acid is added to extracts from washed kidney pulp, the phosphorylation, which is very slight in preparations without substrate, is increased considerably and the respiratory rate is also accelerated. Since these extracts are very poor in phosphate acceptors, it is most likely that fumarate and malate are converted through oxidation to a phosphate acceptor. A more detailed investigation definitely established the formation of a new phosphoric ester quite different from the hexosediphosphate formed from glucose and fructose[2]. The characteristics of the phosphoric ester formed from the oxidation products of malate agree completely with those of phosphopyruvic acid[3].

Kidney cortex from a fasting rabbit was minced and washed twice with two volumes of ice water. The washed tissue was then ground with sand and extracted with an equal volume of *M*/15 sec. phosphate which contained 0·2 per cent fluoride. Aliquot parts (1·5 c.c.) were incubated in an oxygen atmosphere at 37° for 30 min.

The phosphate analyses were calculated to mgm. P in the entire extract.

	O_2 uptake	Pdir.	Palk.	Pied.	Pmerc.	P_{30}
Control (initial sample)		1·16	1·17	1·18		1·16
Incub. without substrate	474	1·00	1·00	1·02		1·11
Incub. with glucose, 40 mgm.	323	0·75	0·83	0·77	0·75	0·96
Incub. with malate, 15 mgm.	720	0·78	0·78	0·98	1·00	1·12

Pdir. : phosphate determined directly.
Palk. : phosphate after 20 min. incubation in *N*/1 caustic soda.
Pied. : phosphate after 20 min. incubation in *N*/10 alkaline iodine.
Pmerc. : phosphate after 10 min. incubation in neutral mercuric chloride.
P_{30} : phosphate after 30 min. hydrolysis in *N*/1 hydrochloric acid at 100°.

The ester derived from malic acid has not been isolated, but since it is hydrolysed by mercuric chloride, which is a specific reagent for the hydrolysis of acetal esters, it is probably the phosphoric ester of the enolic form of pyruvic acid. The phosphopyruvic acid could not originate from traces of sugars because fluoride inhibits the formation of this compound from phosphoglyceric acid. The esterification product, however, contains no phosphoglyceric acid, since the P_{30} value indicates that no acid resistant ester is formed from malate. It therefore appears that the phosphopyruvic acid had its origin from oxalacetic or pyruvic acid derived from the oxidation of malic acid. Malate is converted to carbohydrate in the kidney cortex[4], and it appears from these facts that phosphopyruvic acid is an intermediate in the formation of sugars from malate and lactate (cf. Green[5], Meyerhof[6]).

HERMAN KALCKAR.

Institute of Medical Physiology,
University of Copenhagen.
Sept. 22.

[1] Kalckar, XVI Internat. Congr. of Physiology, Zurich (1938).
[2] Kalckar, *Enzymologia*, **2**, 47 (1937).
[3] Meyerhof and Lohmann, *Biochem. Z.*, **273**, 60 (1934).
[4] Benoy, M., Baker, Z., and Elliott, K., *Biochem. J.*, **31**, 1268 (1937).
[5] Green, Needham and Dewan, *Biochem. J.*, **31**, 2327 (1937).
[6] Meyerhof, Ohlmeyer and Möhle, *Biochem. Z.*, **297**, 90 (1938).

Diffusion of Phosphate Ions into Blood Corpuscles

WE find on shaking labelled (radioactive) sodium phosphate of negligible weight with blood, that phosphate ions quickly enter the erythrocytes. In the course of three hours, nearly half the phosphate ions present in the plasma of rabbit's blood diffuses into the corpuscles. When labelled phosphate ion enters the cell, it becomes available for esterification processes. Simultaneously, non-labelled phosphoric acid-ester molecules decompose, producing non-labelled phosphate which diffuses into the plasma; this process is going on incessantly. There is thus a rapid interchange of phosphorus atoms between plasma and cells. In *in vivo* experiments, using a newly developed technique[1], we find the same rate of penetration of phosphate ions into corpuscles as occurs *in vitro*. In both cases, not all the acid-soluble organic phosphorus compounds exchange their phosphorus for the labelled variety, and it is of interest to note that a large part of the phosphorus esters which resist hydrolysis when heated for an hour at 100° with mineral acids do not become labelled in the course of a few hours.

In order to compare the rate of diffusion of the phosphate ion and that of ester molecules, in some of our experiments we added labelled hexosemonophosphate (kindly presented to us by Prof. Parnas) to blood. We find that if hexosemonophosphate diffuses at all into cells, the rate is at least ten times less than that of phosphate ions. In *in vitro* experiments, labelled hexosemonophosphate was found to be to a large extent decomposed, presumably by Robison's bone phosphatase present in blood. The rate of hydrolysis is that of a monomolecular reaction, the velocity constant being 0·0024 min.$^{-1}$. The enzymatic decomposition of the ester also takes place in the absence of corpuscles. In the intact animal, the blood comes in rapid and intimate contact with the large surface of bone tissue containing the

enzyme and in *in vivo* experiments, a rapid decomposition of hexosemonophosphate was observed. In the course of an hour and a half, more than 99·9 per cent of labelled hexosemonophosphate injected into the vein of a rabbit left the circulation. As mentioned in a previous communication[2], no labelled phosphatides, or at most only a minimal amount, was formed in the blood, these substances being liberated from the liver and other organs into the circulation.

A detailed report of our experiments is being published in the proceedings of the *Kgl. Danske Videnskabernes Selskab. Biol. Medd.* We wish to express our thanks to Profs. Niels Bohr and Einar Lundsgaard for putting numerous facilities at our disposal, and to Miss Hilde Levi for making the determinations of activity of the preparations.

A. H. W. Aten, jun.
G. Hevesy.

Institute of Theoretical Physics,
Copenhagen.
Sept. 30.

[1] Cf. Hevesy, G., *Enzymologia* (in the Press).
[2] Hevesy, G., and Rebbe, O., Nature, **141**, 1097 (1938).

Bone Tumours and Œstrone

Recent experiments on mice from our sarcoma strain are producing results of sufficient importance to be communicated now, although the experiments are by no means complete.

We have shown[1] that there is a very marked sex-difference in the incidence of bone tumours, 77·3 per cent of the females and only 29·6 per cent of the males dying from this cause. The mean bone tumour age for females is 15·3 months and for males is 17·7 months; the youngest tumour-bearing female was five months, and the youngest tumour-bearing male was six months old.

In an attempt to increase the tumour incidence in males, experiments with œstrogenic compounds were begun less than three months ago. Through the generosity of the Organon Laboratories, we were supplied with a number of 5 mgm. tablets of œstrone. Young males, between three and four weeks old, each received one tablet implanted subcutaneously into the left flank.

During this last week, a number of these animals have shown symptoms of retention of urine, causing death in two cases; five other mice were killed before the symptoms became too pronounced. Both the dead mice had enlarged pituitary glands, but the others seemed to be normal in this respect. All the animals were undersized, and showed atrophy of the genital organs; retention of urine seemed to be due to prostatic enlargement. One mouse had bilateral hydronephrosis.

Three of the animals which were killed had bone tumours; one had osteomata of the right femur and right tibia; another had an osteoma of the right femur and two osteomata on the ribs; the third had an osteoma on a rib and early neoplastic changes in the right femur. These mice were all 3–3·5 months old; the implants had been in position for about 2·5 months. Another animal of the same age showed signs of early neoplastic changes in the femora, and the fifth mouse, only two months old, and implanted with a tablet one month previously, had definite alterations in the right femur. It is impossible without microscopic examination to say anything concerning the bones of the two mice which died, yet they appeared to be abnormal. All the bones suspected of neoplastic changes will be examined microscopically, but there may be some delay before this can be done; of the gross changes there is no doubt.

The implanted tablets were recovered from each animal and weighed: it was found that each mouse had absorbed 20,000–30,000 international units of œstrone.

Painting experiments are also in progress in which the animals receive a much smaller dose of œstrone. An adequate number of control mice is being kept; so far, these show no sign of tumour formation.

It is not suggested that, as is probable in the case of mammary carcinoma, these bone tumours arise directly by the action of œstrone on the tissues concerned. In this respect, it is worth noting that the sarcoma strain has a much lower incidence of mammary tumours (14·1 per cent) than its parent Simpson stock (50–73 per cent). Recent work by Cramer and Horning[2], Zondek[3], and others shows that there is a close relationship and balance maintained between the different endocrine glands, and a large overdose of one hormone may upset the balance and alter the rate of hormone production in other glands. These experiments may provide evidence as to which gland is responsible for the formation of the hereditary bone tumours.

F. C. Pybus.
E. W. Miller.

J. H. Burn Research Laboratory,
Royal Victoria Infirmary,
Newcastle-upon-Tyne.
Oct. 3.

[1] Pybus, F. C., and Miller, E. W., *Amer. J. Cancer*, **33** (in the Press).
[2] Cramer, W., and Horning, E. S., *Lancet*, i, 247 (1936).
[3] Zondek, B., *Amer. J. Cancer*, **33**, 555 (1938).

Polarographic Proof of Proteolysis in Diagnosis with Enzyme Reaction

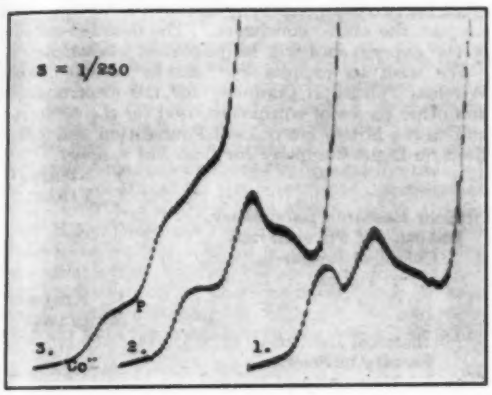
During recent years, Fuchs's reaction has been widely applied for the diagnostics of malignant tumours. Fuchs[1] has found that normal serum is able to decompose the fibrin prepared from carcinomatic blood; on the other hand, serum from a patient suffering from a malignant tumour decomposes the fibrin obtained from the blood of a normal individual. He proved the proteolysis by the increase of the non-protein nitrogen—a method proposed already by Abderhalden[2]—or by determining the ratio of carboxylic and amino-groups before and after the proteolysis.

The determination of the non-protein nitrogen increase due to the proteolysis is the most delicate problem of this procedure, and often leads to difficulty in interpretating the experimental results. On the basis of the polarographic investigations of proteins as carried out by R. Brdička[3], a new way has been made possible by which the proteolytic cleavage can be followed exactly[4]. Thus we applied Brdička's test which indicates the disulphidic or sulphydryl groups of proteins and their decomposition products, for the proof and measurement of the proteolysis.

We followed in our experiments a modification of the original Fuchs reaction described by Chrometzka and Gottlebe[5], in which method the aseptic ultrafiltrate of the serum is used instead of serum. We filtered the sera in the Tisen apparatus, which was

carefully sterilized, through membrane filters "impermeable to proteins" and we used the filtrate for the modified Fuchs reaction. It has been shown by the above-named authors that the proteolytic activity of the serum is increased when the serum is freed from proteins. A further advantage of using the serum filtrates consists in the fact that the liquid, after the proteolysis, does not need to be deproteinated. Such a deproteination in the case of serum leads to the precipitation of higher proteolytic products with proteins, whereby the effect of the proteolysis is lessened.

We put 0·5 c.c. of the ultra-filtrate into each of three sterilized test-tubes. The first sample served as a control; to the second sample 5 mgm. of fibrin prepared from the blood of a normal man was added, and to the third one the same amount of a carcinomatic fibrin. After an incubation period at 37° C., the samples were filtered through a hard filter paper and a certain amount of the filtrates were mixed with an equal amount of the Brdička buffered cobalt



POLAROGRAPHIC EVIDENCE OF PROTEOLYSIS IN THE FUCHS MODIFIED REACTION.

CURVE 1. POLAROGRAPHIC EFFECT OF THE SERUM ULTRAFILTRATE. CURVE 2. PROTEOLYSIS OF CARCINOMATIC SUBSTRATE WITH CARCINOMATIC SERUM (SLIGHTLY POSITIVE). CURVE 3. PROTEOLYSIS OF NORMAL SUBSTRATE WITH A CARCINOMATIC SERUM (STRONGLY POSITIVE). THE SERUM WAS TAKEN FROM A PATIENT SUFFERING FROM CA MAMMÆ.

solution. These solutions were then submitted to polarographic analysis and the usual current-voltage curves were recorded. It should be mentioned that the fibrin filtrate alone does not show any protein reaction.

The result of such an experiment is shown in the accompanying curves.

The first current-voltage curve, due to the ultra-filtrate in the Brdička buffered cobalt solution, proves that the membrane filter does let some small amount of protein substances, giving the Brdička protein test, pass through. Curves 2 and 3 are due to solutions of ultra-filtrates incubated with carcinomatic and normal fibrin respectively; in the test solution of ultra-filtrate where the proteolysis of fibrin took place, an appreciable 'double wave' (*P*)—the Brdička protein reaction—appears on the current voltage curve (see Curve 3), whereas in the ultra-filtrate which reacted with the corresponding substrate to a small extent only, this effect is slight (Curve 2). Thus it is evident that the proteolysis proceeds in both ultra-filtrates, but the effects differ in the height of the 'double wave' caused by the products of proteolysis. Hence the height of this 'wave' indicates objectively the degree of proteolysis in a way similar to the determination of the increase of non-protein nitrogen, the latter method being beyond comparison more difficult from the technical point of view.

From similar experiments—altogether fourteen have been carried out—it follows that the Brdička polarographic test for proteins and their decomposition products enables one to prove in a simple and exact way that proteolysis occurs in reactions of serum filtrates with substrates. A similar mode of procedure was used by Brdička and Klumpar[4] in their study of proteolytic cleavage of proteins with pepsin. We believe that these findings will lead to far-reaching applications of the polarographic effect to various reactions based on the proteolysis of specific substrates. It will be useful also for the study of different organic dysfunctions and physiological disorders.

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Charles' University,
Prague.
Sept. 6.

[1] Fuchs, H. J., *Biochem. Z.*, **170**, 76; **175**, 180; **176**, 32 (1926); **178**, 155 (1927).
[2] Abderhalden, E., "Abwehrfermente" (Berlin, 1922); "Handbuch d. biol. Arbeitsmethoden" (Berlin, 1932).
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Colorimetric Determination of *dl*-α-Tocopherol (Vitamin E)

INVESTIGATIONS of Evans[1] and Karrer[2] have demonstrated that α-tocopherol possesses reducing properties, so that it can be determined by potentiometric titration with gold chloride.

Our colorimetric determination is based upon the reducing power of α-tocopherol against ferric chloride. The ferrous salt which is formed has been determined by us with α-α′ dipyridyl. The reaction is carried out in ethanol and the red colour of the ferrous-dipyridyl complex has been determined with a Zeiss-Pulfrich photometer (screen 50 and 1 cm. cell). The quantities of α-tocopherol which have been determined varied from 0·01 to 0·4 mgm.

We also have determined α-tocopherol (Hoffman – La Roche) by Karrer's potentiometric titration with gold chloride, and the two methods give results in good agreement. In both methods carotene may cause difficulties.

Details and applications will be published elsewhere.

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Oct. 14.

[1] *J. Biol. chem.*, **113**, 319 (1936).
[2] *Helv. chim. Acta*, **21**, 939 (1938).

Colour Reactions of Urine

A sample of urine containing about 2 per cent of free sulphuric acid and treated with certain oxidizing agents, as for example, potassium dichromate, potassium permanganate, ammonium persulphate, iodine or iron sesquichloride respectively (the latter two at a high temperature), produces a reddish pigment which may be destroyed even by a slight excess of those reagents. A chromogen of urine which is responsible for this colour reaction is derived probably from some nutrient material, for urine of carnivora (lion and wolf) develops only a brownish colour, while that of man and pig is an intense wine-red, and urine of herbivora (cow, horse and sheep), fed on a plant material containing photoxan[1], gives a rose-red pigment[2].

This colour reaction may be very helpful in physiological investigations of metabolism, and also for certain diagnostic purposes.

A. Kozlowski.

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Oct. 6.

[1] Kozlowski, *Acta Soc. Bot. Pol.*, **15**, 1 (1938).
[2] Kozlowski, *Acta Soc. Bot. Pol.*, **15**, 227 (1938).

Dioxymaleic Acid Oxidase

In a previous paper[1], two of us reported on the existence of a vegetable dioxymaleic acid oxidase. We wish to correct our statement that this enzyme is not sensitive to cyanide. The function of this catalyst, prepared from sorrel (*Rumex acetosa* L.) by acetone precipitation of the juice of the leaves, is inhibited completely by 0·0001 *M* hydrogen cyanide at *p*H 4, where the enzyme has a sharp optimum. Comparative studies suggest that this ferment is one of the three basic ærobic oxidases of the vegetable kingdom, the other two being the polyphenol and ascorbic oxidase. The enzyme oxidizes the acid reversibly, the H being oxidized to H_2O_2.

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Oct. 14.

[1] *Z. physiol. Chem.*, **255**, 57 (1938).

Artificial Production of Uranium Y from Thorium

Artificial radioactivity induced in thorium by neutron bombardment has been studied by various authors[1]. Meitner, Strassmann and Hahn[2] especially have recently published the results of their detailed investigations, according to which they ascertained the production of a thorium isotope ^{233}Th (26 min.) and three isomers of a radium isotope ^{233}Ra (< 1 min., 15 min. and about 4 hours).

We have also been studying the same problem for some time, and so far as the above results are concerned, we seem to be in general agreement with the last-mentioned authors. Besides these isotopes, moreover, we obtained another thorium isotope which we identified with uranium Y, the parent substance of protactinium, the thorium series thus being changed over to the actinium series.

Thorium nitrate, carefully freed from mesothorium as well as from other disintegration products except radiothorium, was exposed to fast neutrons which were produced by bombarding lithium with 3 Mv. deuterons obtained by means of our cyclotron. After the exposure, which ranged from three to fifteen hours, thorium was chemically separated from the sample. This showed two periods of β-decay, one of which we identified with that of ^{233}Th as above mentioned.

The other period of 24·5 hours was surmised to be due to a thorium isotope which was produced from thorium through loss of neutrons. This ought to give uranium Y according to the following reaction:

$$^{232}\mathrm{Th} + {}^{1}n \rightarrow {}^{231}\mathrm{UY} + 2{}^{1}n.$$

In fact the above period coincides with that of uranium Y (24·6 hours) in accordance with our supposition.

The sign of the β-rays was shown to be negative and the measurements of their absorption in aluminium gave an absorption coefficient of 246 per cm., which is not very far from 300 per cm. found by Antonoff, and lies between 52·95 and 585 per cm, given for two components by Erchova[3]. All these facts support the above conclusion. The detailed account of the experiments will be published elsewhere.

We wish to express our thanks to the Japan Wireless Telegraph Company for the electromagnet and other pieces of equipment used for the cyclotron, and to the Mitsui Ho-onkwai Foundation and Tokyo Electric Light Company for financial support.

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Sept. 13.

[1] Fermi, E., Amaldi, E., D'Agostino, O., Rasetti, F., Segrè, E., *Proc. Roy. Soc.*, A, **146**, 483 (1934); Hahn, O., and Meitner, L., *Naturwiss.*, **23**, 320 (1935); Amaldi, E., D'Agostino, O., Fermi, E., Pontecorvo, B., Rasetti, F., Segrè, E., *Proc. Roy. Soc.*, A, **149**, 522 (1935); Curie, I., v. Halban, H., and Preiswerk, P., *C.R.*, **200** 1841, 2079 (1935); *J. Phys. et Rad.*, **7**, 361 (1935); Rona, E., and Neuninger, E., *Naturwiss.*, **24**, 491 (1936); *Mitteil. Inst. Radiumforschung*, No. 384, 479 (1936).
[2] Meitner, L., Strassmann, F., and Hahn, O., *Z. Phys.*, **109**, 538 (1938).
[3] Erchova, *J. Phys.*, **8**, 501 (1937).

Magnetic Properties of Superconductors

Using a ballistic method, we have measured the magnetization curve of the superconducting alloy Au_2Bi; for a specimen built up of separate small crystals we obtained the curve in Fig. 1. It will be seen that there is practically no 'tail' to the curve, and that the hysteresis is much less marked than for a typical superconducting alloy; in fact, the magnetic behaviour approximates to that of an 'ideal' superconductor. Such hysteresis as there is, is probably due to very slight impurities in the specimen, rather than to the irregular shape, since a similar specimen made up of small irregular lumps of very pure tin (an 'ideal' superconductor) showed much less hysteresis.

Since Au_2Bi is an alloy of definite composition (it is not soluble in either gold or bismuth[1]), this resemblance to the behaviour of an 'ideal' superconductor confirms the view that the anomalous

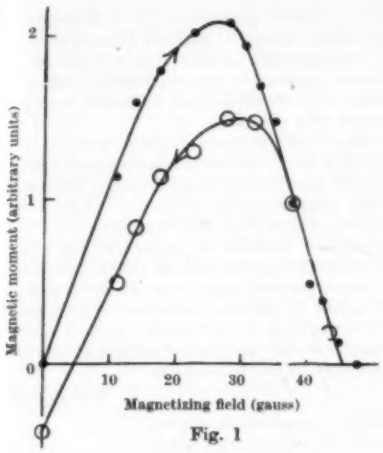

Fig. 1

behaviour of superconducting alloys is due not to the fact that they are alloys, but to some secondary cause such as inhomogeneity of composition.

In Fig. 2*a* we show the H_c-T curve obtained for Au_2Bi, and it will be seen that the H_c values are considerably lower than those obtained in Leyden from resistance measurements on the Au-Bi eutectic[2], and that the transition temperature of our specimen (about 1·73° K.) is lower than that found in Leyden (1·84° K.). These discrepancies may be due to the presence of very fine threads of Au_2Bi (separated from each other by free bismuth) in the eutectic, which, on account of their thinness, may perhaps remain superconducting at higher fields and temperatures than the crystals used in our measurements.

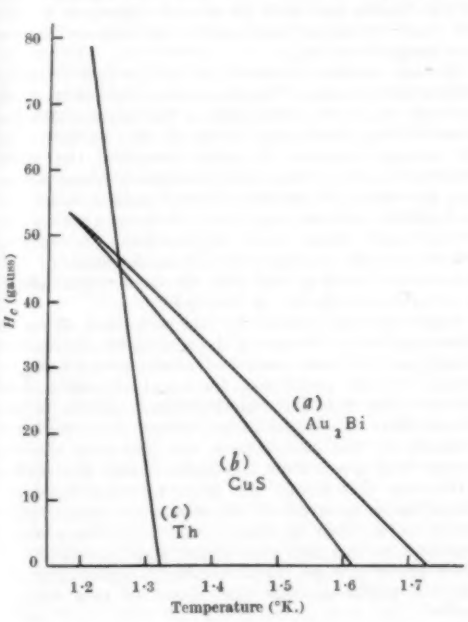

Fig. 2

We did not succeed in obtaining 'ideal' behaviour in the case of the superconducting compound CuS (this may have been due either to insufficient purity of the constituents, or to the presence of Cu_2S in our specimens); although there was a marked hysteresis, the 'tails' of the magnetization curves were not very pronounced, and it was possible to determine the critical field at different temperatures. The H_c-T curve is shown in Fig. 2*b*, and the transition temperature (1·61° K.) agrees with that found by Meissner[3]. It will be noticed that both Au_2Bi and CuS have low values of dH_c/dT, of the same order of magnitude as the 'soft' group of superconductors[4]; this may be connected with the fact that in the case of both these alloys, the two components lie immediately on one or the other side of this group in the periodic system.

While testing the measuring apparatus, we measured also the H_c-T curve of thorium (not previously measured), shown in Fig. 2*c*. As with all the other 'hard' superconducting elements, dH_c/dT is considerably higher than for the 'soft' superconductors[4], and also (probably due to impurities) the magnetic behaviour resembles that of a typical alloy rather than of an 'ideal' superconductor. The difference between the transition temperature of our specimen (1·32° K.) and that found by Meissner[5] (1·49° K.) is probably due to difference of purity.

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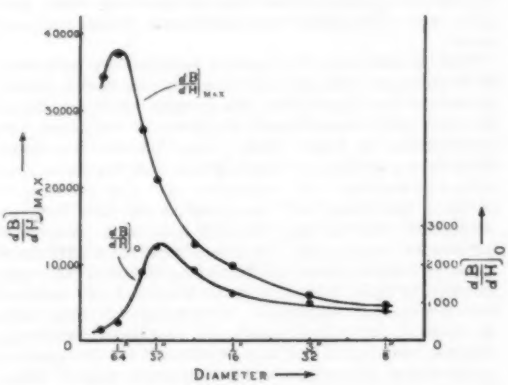
Sept. 10.

[1] Jurriaanse, *Z. Krist.*, **90**, 322 (1935).
[2] de Haas, van Aubel and Voogd, *Leiden Comm.*, 197b (1929).
[3] Meissner, *Z. Phys.*, **59**, 570 (1929).
[4] Daunt and Mendelssohn, *Proc. Roy. Soc.*, A, **160**, 127 (1937).
[5] Meissner, *Z. Phys.*, **60**, 181 (1930).

Magnetic Quality of Iron Wire as influenced by the Diameter

In a previous note[1] the results were given of tests on Armco iron wire of various diameters when heated in hydrogen to a condition of maximum permeability at a temperature of 1,200° C. A number of the magnetization curves so obtained have been analysed and the values of the maximum slope, $\left.\frac{dB}{dH}\right]_{max.}$, and



also the values of the slope at the origin, $\left.\frac{dB}{dH}\right]_o$, respectively, have been plotted as a function of the diameter of the wire. In this way the two curves shown in the accompanying graph have been obtained.

Each of the curves has a well-defined maximum value, and the general character of each curve can be accounted for if it be assumed that: (i) the wire has a magnetically hard surface layer; (ii) the process of magnetization commences at the surface of the wire and proceeds progressively towards the axis by a kind of 'chain-effect', so that the magnetic induction is greatest near the surface and progressively decreases towards the axis of the wire.

Further tests are being carried out at higher temperatures, and a full account of the results will be published elsewhere in due course.

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Oct. 3.

[1] Nature, 141, 205 (Jan. 29, 1938); also *The Engineer*, June 24, 1938.

Diffraction Patterns Produced by Surfaces in Sunlight

The reflection of sunlight from various surfaces, including those of finger nails, skin, paper, wood, plant leaves, and glass slides covered with thin films of dried blood, produces mosaic-like varicoloured patterns which yield to the unaided eye an impression of the presence of many small but discrete coloured granular particles. The coloured mosaics are particularly brilliant when the surfaces are viewed near grazing incidence, although in some instances the effect is clearly evident from other angles. Such patterns are not evident on the polished surface of glass. The optical irregularity of the former surfaces is commonly evident to the unaided eye only by the generalized cloudiness or haziness. The mosaic pattern is readily seen when the reflecting surface, adjusted to an appropriate angle, is placed at a distance of approximately four to fourteen inches from the eye. At greater distances the detail of design is lost. At lesser distances the chromogenic features are not apparent. An illusion of flow of the coloured 'particles' is produced by slight tilting of the surface while under observation. It thus appears as if different groups of surface projections come into play with a resultant rearrangement of the coloured spots.

The production of coloured patterns by reflection of white light from surfaces is a commonly recognized phenomenon. However, the mosaic effect produced by the above-mentioned surfaces is different, in appearance at least, from those which have been described previously. Among the well-known colour effects produced by reflection are the colours of striated surfaces and the colours of fine laminar structure. The former, usually seen as a pattern of concentric rings upon the finely scratched surface of glass and metal, was attributed by Tyndall[1] to interference of light reflected from the opposite sides of the furrows or scratches. The coloured areas seen in certain shells and pearls are associated with fine laminar structure and are attributed to the class of phenomena associated with Newton's rings. There is a conceivable similarity of the colours of the mosaic to those produced by reflection of light through multi-layers of surface films spread on metal plates[2], except that in the former instance the areas of a given thickness are extremely small and the reflecting foci are tilted at different angles; hence the mosaic-like effect.

The fact that the mosaic effect appears in sunlight and in light from distant incandescent lamps, while not in light originating from a nearby source, suggests that the phenomenon is to be classed with the Fraunhofer diffraction phenomena[3].

The mosaic pattern is apparently a consequence of the mutual interference of diffraction bands produced when parallel light rays strike the small component parts of certain surfaces. This regularity of the chromogenic interference mosaic for certain materials provides additional means of characterizing the structure of such surfaces.

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Pennsylvania.
Sept. 9.

[1] Tyndall, J., "Lectures on Light" (D. Appleton and Co., N.Y., 1873).
[2] Langmuir, I., Schaefer, V. J., "Built-up Films of Proteins and their Properties", *Science*, **85**, 76 (Jan. 15, 1937).
[3] Wood, R. W., "Physical Optics" (new and revised edition; The Macmillan Co., New York, 1929).

Cause of Earthquake Ruptures

At present there is no established theory of the cause of earthquake ruptures because of their diversity. Observations in Cordoba of the San Luis shocks of May 1936, including records on a sensitive Richard barograph at the National Observatory, have suggested that this diversity of behaviour is due chiefly to differences of depth, of dip and strike of the faults, and that barometric pressure is often the final actuating cause which determines the hour and perhaps the day.

Actual cracks observed in the surface in many places confirm that the underlying conditions in the tectonic type of earthquake is an accumulation of strains along geological faults in the earth's crust, the sudden release of which produces the shock. Whatever the position and direction of these strains, the gravitational pressure of the masses must tend to hold the surfaces together. Without gravitational pressure, no strain could accumulate. A sufficient *release* of such pressure will cause a rupture. Confirmation of this is found in the cases where shocks have occurred chiefly at low tide.

Tidal stresses caused by the sun and moon are alone capable of effectively decreasing these pressures. Nearly all extensive series of observations have disclosed a slight preference for times of new and full moon. The San Luis earthquakes referred to suggested that in deep shocks, where the gravitional pressure of the mass above was greatest, the connexion was closer than in shocks nearer the surface.

To test this point, the most destructive shocks, fifty-nine in number, in the past three centuries, for which data could be found, and forty heavy shocks reported in the past two years, were examined. In both these groups, approximately eighty per cent showed preference for the times of new and full moon.

These same shocks showed a preference for the times of lunar perigee. Extensive series of after-shocks

in the disastrous earthquakes of 1891 in Gifu and 1897 in Assam show preferences during several months for the times when new and full moon occurred near perigee.

These facts establish a definite relationship with sun and moon which can only be interpreted as gravitional. From its nature gravitation, if present in some cases, must be present in all whether its effects are directly noticeable or not. Differences of dip and strike in the faults can account for deviations from new and full moon. Evidence confirmatory of this explanation is found in the Inverness earthquake of 1901 and those generally in Calabria and Japan.

Existing evidence appears sufficient to establish the thesis that *the ruptures due to earthquake stresses about geological faults are due primarily to the gravitational action of the sun and moon.*

Shocks recorded in Cordoba during or just after sharp diurnal or sporadic 'lows' of the barometer suggest that these are the final controlling factor which in many cases determines the hour and even day.

A gravitional theory permits the prediction of the majority of heavy destructive shocks within two or three days.

C. D. Perrine.

Cordoba.
Sept. 11.

Biological and Cytological Observations on Tenthredinid Parthenogenesis

During the past three years, I have made certain findings regarding two species of Tenthredinidæ, and as their detailed publication will be delayed owing to my departure abroad, I take the opportunity to state them briefly.

It is well known that the species *Pristiphora pallipes* Lep. reproduces by thelytokous parthenogenesis but very occasionally produces males. The chromosome constitution of the female is 16, as determined from oogonia, follicle cells, and embryo cells; that of the male appears to be 8, from spermatogonia and second spermatocytes.

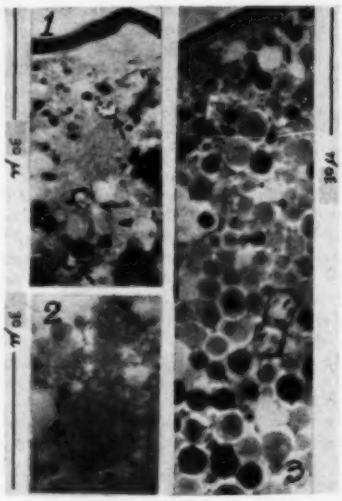
In oogenesis there are two maturation divisions (Fig. 1). That reduction takes place in the first division is indicated because 8 chromosomes are found in the second anaphase (Fig. 2). These chromosomes appear double at times and this, along with the fact that the second division follows immediately after the first, can be taken to mean that the chromosomes are split ready for this second, equational, division. The result of these divisions is that four nuclei are formed in line (Fig. 1). Later, the female pronucleus and second polar nucleus approach and lie pressed together, deeper in the yolk, as if for fusion (Fig. 3).

These facts therefore indicate that egg maturation is similar to that of normal bisexually reproducing animals, and that the diploid condition is restored by fusion of egg pronucleus and second polar nucleus, a condition comparable to that already known in certain other animals showing obligatory (for example, *Artemia*), facultative (for example, *Lecanium*), and experimental (for example, *Asterias*), parthenogenesis. The maturation appearances up to the four nuclear stage are similar to those figured by Doncaster[1] for *Pteronidea* (*Nematus*) *ribesii* Scop., but my findings regarding the fusion of the female pronucleus and the second polar nucleus are new.

Further support for my interpretation is seen from such details of the prophase stages of meiosis as I have worked out; leptotene, synizesis, and pachytene all appear to be normal, although the pairing of chromosomes has not yet been detected with certainty.

An interesting fact concerning the first polar nucleus is that in several cases spindles have been observed which, from their position, appear to be the fusion product of the daughters of the first polar nucleus. The appearances are similar to Doncaster's 'fusion nucleus', which he considers is formed from the second polar nucleus and the inner daughter of the first polar nucleus.

More than 1,700 eggs were examined, about 943 (54 per cent) proving of use. Of the latter, 191 gave first division stages, 106 those of the second division, 254 the four nuclei stage, and 94 gave fusion stages. The other 298 are as yet unclassified.



Oogenesis of *Pristiphora pallipes*.

1: Completion of maturation; four nuclei indicated by arrows, outermost nucleus faint and not in same plane as other nuclei.
2: Anaphase plate of second spindle; reduced number (8) of chromosomes.
3: Egg pronucleus and second polar nucleus set for fusion deep in yolk.

A 'gynandromorph' showing complete male external genitalia and almost complete but distorted female external organs was also found. The gonads and internal genitalia were male in appearance. Again, a larva, the gonads of which were female in gross appearance, contained what appear to be male cells.

In the second species, *Priophorus tener* Zad., rearing experiments with six unmated females from wild larvæ gave only males. However, three other unmated females from wild larvæ produced only females (six larvæ and seven flies), and from four of these another generation of parthenogonic females (four) was obtained. The oogonia showed 12 chromosomes and the spermatogonia 6. The mechanism of chromosome number control is unknown in this case. This adds another example to the few species already

known to be not exclusively arrhenotokously or thelytokously parthenogenetic[2]. It is evident that the biology of saw-flies will well repay further study.

Thanks are due to Prof. A. D. Peacock, under whose supervision I have worked, for the provision of certain material; to Dr. Ann R. Sanderson, for the benefit of her experience in similar work; and to Mr. A. T. Baxter for laboratory assistance.

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[1] Doncaster, L., *Quart. J. Micr. Sci.*, **49** (1906) and **51** (1907).
[2] Peacock, A. D., *Tijdsch. v. Entomologie*, **81** (1938).

Nitrogen Fixation by Blue-Green Algæ

In India, rice is grown on the same land for many years without the addition of manures to the soil. Preliminary experiments have shown that a considerable amount of nitrogen is fixed in the soils of the rice-fields under water-logged conditions, when there is an abundance of algal growth (especially Blue-green Algæ) present. With the object of investigating the role of the Blue-green Algæ, a number of species of *Anabæna*, as well as *Phormidium foveolarum*, were isolated in unialgal culture from the soil of an Indian rice-field. The last, as well as three species of *Anabæna*, were afterwards obtained in pure culture, altogether devoid of bacteria and other contaminating organisms, by a method analogous to that employed by Pringsheim (1913). These cultures have been tested by the Bacteriological Department at the Rothamsted Experimental Station and pronounced free from bacteria.

Inoculations from these pure cultures, grown in mineral solutions lacking nitrogen (apart from that contained in minute traces of soil-extract), showed that, while the *Phormidium* has no capacity for fixation of nitrogen, the three species of *Anabæna* are able to fix considerable quantities, averaging 3–5 mgm. of nitrogen per 100 c.c. of medium in about two months. The amount of nitrogen fixed by the Algæ in the presence of *Azotobacter* and other bacteria is the same as in the pure cultures, from which it appears that bacteria play a relatively unimportant part in nitrogen fixation in the rice-fields.

The effect of the presence of various organic compounds on the process has been examined. Certain soluble carbohydrates (arabinose, maltose, raffinose, inulin and dextrin) have a decidedly inhibiting effect on nitrogen fixation; but the process will go on in the presence of soluble nitrogen compounds. Iron is not essential for nitrogen fixation.

Diverse workers (Molisch 1926, Vouk and Wellisch 1931, Copeland 1932) have previously affirmed nitrogen fixation by Blue-green Algæ, but the evidence as to the purity of their cultures is not adequate. Drewes (1928) and Winter (1935) used several bacteriological agar media to test the purity, but the evidence is inconclusive, since on such media, in the presence of Algæ, there may be no visible growth of bacteria although present. A similar criticism applies to the researches of Allison and co-workers (1932 and 1935).

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Normal Dentition of Sharks

When the teeth of the various rows in the jaw of *Carcharias melanopterus* at different ages are compared, one observes an exposed row of teeth slightly smaller than the unerupted ones behind it, and incomplete hindermost rows of what appear to be vestigial remains of teeth which can never come into use. Mr. G. P. Whitley, of the Australian Museum, has kindly referred me to Gudger and Smith's memoir[1] on "the most primitive shark", *Chlamydoselachus*, and notes "unfortunately the problem of their replacement has not been touched upon, else considerable light might have been thrown on the matter. From fossil sharks too there are no apparent data on this point".

In this memoir, which I have seen from the South African Museum, the small teeth of *Chlamydoselachus* are regarded as employed for retaining the food that is seized, rather than for chopping off pieces like the broad teeth of *Charcharodon* and *Galeocerdo*.

If the exposed teeth of these latter were constantly shed and replaced from the unerupted teeth, one would expect to find in an adult the largest teeth exposed or lacking in serration through constant use.

F. G. Cawston.

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West Street,
Durban.

[1] Gudger, E. W., and Smith, B. G., "Natural History of the Frilled Shark, *Chlamydoselachus anguineus*", Bashford Dean Memorial Volume, Art. 5, No. 23, 277 (1933).

Mesotron (Intermediate Particle) as a Name for the New Particles of Intermediate Mass

The existence of particles intermediate in mass between protons and electrons has been shown in experiments on the cosmic radiation[1]. Since at present so little is known concerning the properties of these particles, for example, the exact value of the mass, the laws governing their production, their stability against disintegration, etc., it may yet be too early to assign to them a name. But inasmuch as several names have already been suggested, namely, dynatron, penetron, barytron, heavy electron, yukon and x-particle, it may be wise to consider the matter at this time.

The property which so far serves to distinguish the new particles from the other two types of particles which carry the same magnitude of electric charge, namely, the proton and the electron, seems to be the magnitude of their mass. Although from the experiments so far performed, it is not possible to say definitely whether the new particles exist with a unique mass only, or whether they occur with a range of masses, it does appear quite certain that the mass, whether unique or not, is greater than that of an electron and less than that of a proton. One must consider then three types of particles all carrying electric charges of equal magnitude: electrons, the new particles and protons. We should like to suggest therefore the word 'mesotron' (intermediate particle) as a name for the new particles. It appears quite likely that the appropriateness of this name will not be lost, whatever new facts concerning these particles may be learned in the future.

Carl D. Anderson.
Seth H. Neddermeyer.

California Institute of Technology,
Pasadena. Sept. 30.

[1] For historical summary see Wentzel, G., *Naturwiss.*, **26**, 273 (1938); and Bowen, Millikan and Neher, footnote, *Phys. Rev.*, **53**, 219 (1938).

Free Radical Terminology

Some confusion appears to be creeping into the literature with regard to the designation of molecules which function as free radicals. Some authors, for example, describe methylene $H_2C=$ as a diradical, and the next step presumably will be to term methine $HC\equiv$ a triradical. This is certain to lead to confusion, since methylene contains a carbon atom with an electron sextet, while a diradical, such as $-CR_2-CR_2-CR_2-$, contains two carbon atoms with an electron septet or free valence. Accordingly, methylene with its electron sextet should be regarded as a bivalent radical. It is true that oxygen, in virtue of its high paramagnetism, is considered to be a diradical, but this refers to the oxygen molecule, –O–O–, with each atom carrying a free valence.

The terms 'odd molecule' and 'even molecule' have now lost much of their original significance, since we are now familiar with even-numbered diradicals and also with charged molecules containing an unpaired electron. Thus the molecule

$$R_2C-\underset{|}{CH}-CH_2-CH_2^+$$

is an even molecule since it contains an even number of electrons. In view of the fact that it is both an ion and a free radical, it is conveniently termed an 'ion-radical'. This serves to avoid confusion with the terms 'radical ion' and 'ionized radical', which have long been in use to designate the triarylmethyl ions, R_3C^+ and R_3C^-, and inorganic ions, such as NH_4^+ and ClO_4^-.

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Oct. 21.

Points from Foregoing Letters

A table showing the amount of phosphate which enters into combination, in presence of oxygen, when glucose or malate is added to minced kidney cortex of a fasting rabbit, is given by Dr. H. Kalckar. The author concludes that malic acid is oxidized to pyruvic acid which combines with phosphate to form phosphopyruvic acid, as an intermediate step in the synthesis of sugars.

Experiments with 'labelled' radioactive phosphate injected into the blood stream show, according to A. H. W. Aten, jun., and Prof. G. Hevesy, that there is a rapid exchange of phosphorus atoms between plasma and cells, that is, between inorganic phosphate and the phosphoric ester in the red blood corpuscles. Hexosemonophosphate penetrates the cells less rapidly but is decomposed within an hour in the blood stream by an enzyme derived from the bones.

F. C. Pybus and Miss E. W. Miller report that œstrone tablets, weighing 5 mgm. each, were implanted subcutaneously into young male mice belonging to a strain in which 77·3 per cent of the females and 29·6 per cent of the males develop bone tumours. Three of these mice have developed osteomata at the age of 3–3·5 months, 2·5 months after the tablets were implanted; the bones of two others showed definite early changes. The average tumour age in males is 17·7 months, and the earliest tumour in an untreated male appeared at the age of six months.

A. M. Kotljar and V. Podroužek submit 'polarographic curves' indicating that the method can be conveniently used to detect the products of protein break-up, such as are formed when normal serum is added to fibrin from a cancer patient, or vice versa.

By exposing thorium nitrate to fast neutrons, obtained by bombarding lithium with 3 Mv. deuterons, Dr. Y. Nishina, T. Yasaki, Prof. K. Kimura and M. Ikawa have produced a radioactive substance with half-period and beta-ray penetrating power identical with those of uranium Y, parent of the protactinium series.

The magnetization curve of superconducting Au_2Bi has been measured by Dr. D. Shoenberg, and it is found to resemble that of an 'ideal' superconducting element rather than that of a typical alloy. Since Au_2Bi, unlike most superconducting alloys, has the same composition and structure throughout its volume, it is inferred that the anomalous properties of most superconducting alloys are connected with inhomogeneity rather than with the fact that they are alloys.

The relationship between the diameter of iron wire and the maximum slope and the initial slope respectively, of the magnetization curves after the wires had been heated to a condition of maximum permeability have been obtained by Dr. T. F. Wall. The results obtained imply that the process of magnetization commences at the surface and proceeds progressively towards the axis.

Out of 59 major earthquakes during the last 300 years, eighty per cent occurred at the time of new or full moon. C. D. Perrine considers this as evidence in favour of the view that the time when ruptures due to earthquake stresses about geological faults take place is determined by the gravitational action of the sun and moon, the tidal action of which brings about the rupture by releasing the pressure.

L. C. Comrie finds in the thelytokously parthenogenetic saw-fly, *Pristiphora pallipes* Lep., that the diploid number in the female is 16, that in the rare male 8. In oogenesis there occur two maturation divisions, reduction, and the subsequent juxtaposing of pronucleus and second polar nucleus, which usually indicates that diploidy is restored by fusion of these nuclei. Two sexual abnormalities have been found. In the species *Priophorus tener* Zad., both arrhenotokous and thelytokous parthenogenesis have been discovered; the female and male counts are 12 and 6 respectively.

Prof. F. E. Fritsch and P. K. De report that pure cultures of the Blue-green Alga *Anabœna* found in Indian rice fields, has been shown to have the property of fixing nitrogen from the air, and they claim that this is the first conclusive proof of the ability of a Blue-green Alga to do so.

Dr. S. T. Bowden directs attention to the confusion which is prevalent concerning odd and even molecules, and the application of the terms radical and diradical. He suggests that a molecule carrying both a charge and a free valence be called an ion-radical in order to distinguish it from the ionized radical and radical ion.

Research Items

Indian Culture and the Native States

Prof. L. F. Rushbrook Williams, in an address to the Royal Society of Arts on the cultural significance of the Indian States (*J. Roy. Soc. Arts*, **86**, Sept. 16, 1938), stressed the position of the States as embodiments of traditional Indian conceptions of socio-political organization, and hence important for the rightful understanding of India's political development. No Government has ever ruled the country from a single centre. Under every Indian empire there have been numerous subordinate kingdoms performing many of the most essential functions of government in territory nominally under imperial control. There are certain fundamental differences between the Western and the Indian views of the State. In Indian ideas, the State deals with the individual, not as such, but as a member of overlapping communal, or local groups, carrying out many forms of corporate action, which the State cannot compass, but essential for the well-being of the citizen. Hence India is a country of communities —village communities, castes or guilds, and the joint-family: and it is only recently that the State has taken over such functions as police, education, or poor relief. Before British rule, the State scarcely came into contact with the individual. The political separatism resulting from these social institutions has been powerfully reinforced by the different cultures, races and languages, which have poured into India since historic times. The subordinate States have played an important part in crystallizing these socio-political institutions, and as supporters of the traditional arts of India, which, but for them, might have perished in the pursuit of Western ideas and culture under the British *raj*.

Properties of the Protoplasmic Membrane

In a recent review of the literature, Harvey and Danielli (*Biol. Rev.*, **13**, 319; 1938) propose a relatively simple model of the surface layers of the cell, based on their physical properties. The tension of the surface lies between 1·0 and 0·1 dynes/cm., which is too low for a simple oil-water interface. The presence of an adsorbed protein film is shown, however, materially to reduce the interfacial tension. On this and other grounds, it is suggested that the surface of the cell involves, as a minimum, a bimolecular layer of lipoid molecules between two layers of protein molecules. Measurements of the thickness of the surface film (about 50 A.), of its permeability, and of its wetting properties are found to be compatible with this model. A simple explanation is given of the Na-Ca type of antagonism in terms of the acidic groups of the protein and lipoid films. Thus, on the alkaline side of the iso-electric point of the membrane, cations will be adsorbed to form salts. It is well known that water is less soluble in the calcium salts of the probable active groups (carboxyl, phosphate, sulphate) than the sodium salts. High temperature coefficients of penetration are also explained without the necessity of the intervention of chemical processes. The membrane allows for preferential absorption of lipoids, and for pore and mosaic effects.

Histamine and Tyramine in Lung Diseases

J. L. Herrenschmidt (*Thèse de Paris*, No. 634; 1938), has made a study of histamine and tyramine in the blood of thirty-one cases of respiratory disease including pulmonary tuberculosis, and comes to the following conclusions. (1) Severe ulcero-caseous tuberculosis is as a rule accompanied by an excess of tyramine and a normal amount of histamine in the blood. (2) In cases of tuberculosis complicated by hæmoptysis, involvement of the pleura, or allergic or cutaneous manifestations, there is little change in the tyramine content but always an excess of histamine in the blood. (3) Broncho-pulmonary suppuration is usually associated with a rise of tyramine and in many cases also of histamine in the blood, and there is always an appreciable or considerable proportion of these two substances in the sputum. (4) In tumours of the lung there is always a considerable quantity of tyramine in the blood. (5) In asthma there is a large quantity of histamine in the blood during an attack and a normal quantity apart from the attacks. The tyramine is normal throughout.

Synthetic Preparation of Ephedrine

This alkaloidal drug is obtained from a shrub growing in a small area near Tientsin, China, and since the recent hostilities in China its price has fluctuated widely. Thus attention is directed to efforts to synthesize the drug, upon which Dr. J. Kamlet of the Israel Zion Hospital, New York City, reported (according to Science Service) at the meeting of the American Chemical Society at Milwaukee in September 1938.

Maturity of Salmon Parr

It has long been known that male salmon parr may mature before leaving the river. These fish were regarded by some as precocious males, and it was not known to what extent maturity was normal. An examination of parr has been made recently in the Welsh Dee (J. H. Orton, J. W. Jones and G. M. King, "The male sexual stage in Salmon Parr (*Salmo salar* L. juv.)", *Proc. Roy. Soc.*, B, **125**, 103–114; 1938). The results showed that 40 per cent of the population of two- and three-years old salmon parr became sexually mature in October 1937. Successful fertilizations were made in November. There is some indication that the parr spawn on the redds before migrating to the sea as smolts. It is suggested that all or most of the males normally attain their first sexual maturity in the river before migrating to the sea. This interesting observation should be followed up by similar work on other rivers.

Insects in Petrified Wood

Evidence of ancient insect activity has lately been brought to light in the fossilized logs of Triassic age found in the Petrified Forest National Monument, Arizona, U.S.A. In many of these fossil trees there are ridges, channels and tunnels which seem to represent the burrows of larvæ of certain beetles. Some of these are channels just under the bark and

appear to be the work of Scolytidæ. Others take the form of tunnels into the heart wood and are perhaps the work of Buprestid or allied beetles. The only species of tree attacked is *Araucarioxylon arizonicum*, and it seems probable that many were killed as the result of girdling by the Buprestid beetles. A short account of these fossilized remains has recently been published by Mr. M. V. Walker (*Proc. United States Nat. Mus.*, **85**, 137–141; 1938), who classifies them into four new genera.

Biology of the Cockroach

THE life-history of the very common and cosmopolitan *Blatta orientalis* L. has long remained very imperfectly known. A contribution towards a knowledge of this subject by Dr. M. A. H. Qadri has recently appeared (*Bull. Entom. Res.*, **29**, 263–276; 1938). Breeding of the insect was at a constant temperature of 27·5° C. It appears that the œthecæ are normally laid in May and June and the time taken for the emergence of the first nymphs is from seven to ten weeks. At the time of its escape from the œtheca the insect is in the so-called pronymph stage, which has been overlooked by most observers. It lasts but a few minutes, after which the first ecdysis takes place. There are six true nymphal instars and at the seventh ecdysis change into the adult occurs. The average developmental period, after exit from the œtheca up to the adult stage, is 279 days. The formation and structure of the little-known spermatophore is described together with the changes during development of the male gonads and their associated parts.

Leaf Abscission in Healthy and Diseased Leaves of *Picea*

A. H. Campbell and A. E. Vines have re-examined the abscission mechanism in *Picea excelsa* (*New Phyt.*, **37**, No. 4, October 1938). It has long been known that this abscission mechanism is actuated by the drying of the leaf, the structural features associated with abscission having been present in the leaf from a very early stage in its development. The authors give grounds for attributing abscission not merely to the loss of water from the leaf but also to its relatively rapid loss. In these circumstances, hygroscopic movements are set up in a thick-walled hyaline layer at the base of the leaf, as the water loss is apparently greater from this layer, in which hygroscopic movements result, than from the leaf cushion, and the tissues separate in this region. The cause of the water deficit in the leaf, it is suggested, may be wound gum deposits in the tracheids; these are seen after leaf-fall but their presence just prior to leaf-fall has still to be established. In one form of the disease attacking spruce needles, *Lophodermellina macrospora*, the infected leaves remain attached to the tree. The authors show that in this case the stomata on the infected leaf are blocked by substomatal sclerotia formed by the fungus hyphæ which, on the evidence of porometer experiments, may be expected to reduce materially the water loss from the leaf, and thus throw out of action the drying mechanism upon which leaf abscission normally depends.

Anthracnose of the Watermelon

THE watermelon plantations of Egypt cover about fifty thousand acres, the produce of which is damaged to the extent of several thousand pounds each year by the fungus *Colletotrichum lagenarium*. Dr. Amin Fikry has given the results of his researches into the incidence and control of this disease in a recent paper (Min. Agric. Egypt, Mycol. Sect., *Bull.* 190, Govt. Press, Bûlâq, Cairo. Price P.T.4. 1938). The fungus causes leaf spotting or anthracnose upon a wide range of varieties, and symptoms usually appear when the plants are about two months old. Almost complete control of the disease has been accomplished by dusting twice with sulphur. The crop must be treated first as soon as the fungus appears, and again three weeks later. Symptoms and control are illustrated in the bulletin by ten half-tone plates.

Past Seismic Activities in Japan

THIS subject has recently been reconsidered by Prof. Akitune Imamura (*Japanese J. Astro. and Geophys.*, **15**, No. 3; 1938). He examines chiefly the activity in Honsyû and Sikoku, since the earthquake history of Taiwan dates only as far back as A.D. 1655. The principal catalogues used in the work are the Dainippon Diain Siryô (*Reports Imp. Earthq. Inv. Comm.*, **46**; 1904) and Omori's catalogue (*ibid.*, **88** *B*; 1919), both going back as far as A.D. 416. The authenticity of the reports of earthquakes mentioned in these catalogues is weighed with records of volcanic outbursts and also with records of tunamis. Imamura considers that the catalogues do not omit any great earthquake, though small ones may not be mentioned. It appears that since A.D. 416 there have been three great periods of seismic activity in Japan, namely, between the years 684 and 887, between 1586 and 1717, and since 1847 continuing at the present time. The table of earthquakes divided into four intensity classes which are defined, and the maps of epicentral regions during the three periods, are very valuable additions to the paper.

Storms in the China Sea

A PAMPHLET entitled "The Law of Storms in the China Sea" by C. W. Jeffries and G. S. P. Heywood has been produced to replace an earlier publication of the Hong Kong Observatory. The earlier work appeared in 1904 under the title "The Law of Storms in the Eastern Seas", and was written by W. Doberck, formerly director of the Observatory. The need for revision arose partly through the virtual disappearance of the large sailing ships, which made a large part of the text of the earlier work meaningless, and partly through the increase of information available about the storms; these it need scarcely be said are the dreaded typhoons of the Far East. The present work contains synoptic charts showing part of the life-histories of some typhoons of recent years and some typical barograms obtained at the Observatory during the approach and recession of storm centres at various distances, with a curve of normal daily pressure variation for comparison. The most interesting and valuable part, however, is the section dealing with the precursory signs of the approach of a typhoon from the point of view of a forecaster at Hong Kong. Swell is noted sometimes 1,000 miles from the centre; it moves outwards from the centre and gives a fair indication of the position of the centre, besides being probably the earliest indication of its approach. It is interesting to note that the barometer is not an unfailing guide to the near approach of a storm centre, an example being the disastrous typhoon of September 18, 1906, which gave no definite barometric indication of its proximity four hours before it was at full strength in Hong Kong harbour. Microseisms are also unreliable as premonitory signs.

Research on Safety in Mines

THE sixteenth annual report of the Safety in Mines Research Board*, including a report on matters dealt with by the Health Advisory Committee, has been published recently by the Mines Department.

In Part 1 a reference is made to the award by the Institution of Mining Engineers of the Medal of the Institution to Prof. R. V. Wheeler (director of the research stations) "in recognition of his eminent services in the application of Scientific Knowledge and Research to industry, with special reference to problems of health in coal mining and of the Utilization of Coal".

In order to promote interest in safety work, each year large parties of miners are invited to visit the Research Station at Buxton to see large-scale coal dust explosions, and last year on each Sunday during the summer these demonstrations were given. The Annual Conference of Mining Teachers was held at Buxton so that modern methods of research and the latest information could be given to them on safety matters. About eighty mining teachers together with representatives of the Board of Education and of the Mines Department attended this conference. Addresses were given on the following subjects: "Education and the Mining Engineer", "Films and their Use for Instructional Purposes" and "Haulage Investigations".

For many years, stone dusts have been used for suppressing explosions by sprinkling the dust on the roof, sides and floor of the roadways in the mine. The dusts used for this purpose have been obtained from shales, limestone and gypsum. In the report, the importance of special material of higher efficacy than the usual stone dusts is mentioned, and the results of the research on this subject are given. It appears that common salt is the cheapest and most effective of these materials. Unfortunately, this material would not fulfil its purpose if exposed to atmospheres of more than 70 per cent relative humidity, on account of its tendency to cake. Experiments with various mixtures have shown that the tendency of powdered crude common salt to cake is much reduced if it is mixed with 20 per cent of finely ground talc (French chalk), precipitated chalk (whiting) or coal. Its caking is entirely prevented by the presence of 10 per cent of tricalcium phosphate or 5 per cent of magnesium carbonate levis. Equally good results were obtained more cheaply with only 2 per cent of magnesium carbonate and 20 per cent of talc or precipitated chalk.

Tests have been made with mixtures of salt, talc and magnesium carbonate under standard conditions of test in a gallery at Buxton 4 feet in diameter, and the calculated efficacy of the salt present in the mixture is approximately ten times that of shale.

In the report for 1936 stress was laid on the importance of choosing a dust of high and lasting dispersability. It has been found that the finer particles are not dispersed as separate particles, and that a dust can be too fine. A dust of fineness between 50 and 70 per cent through a 240 mesh B.S. test sieve containing about 20 per cent of fairly coarse particles over 60 mesh is recommended.

In all mines where coal is won, firedamp is given off. This is diluted by passing pure air round the workings. But if the ventilation is impeded, the percentage of firedamp present in the mine atmosphere may increase or an excessive and unusual amount of gas may be given off for possibly a short period.

It is desirable, therefore, for the mine manager to have information about the percentage of firedamp in the return air. In the past this has been done by analysing 'spot' samples by means of a Haldane or Bone and Wheeler apparatus. The principle which is used for this purpose is to burn the combustible gas and measure the contraction produced.

A very ingenious firedamp recorder is described capable of giving a continuous record of the percentage of gas present in the atmosphere over a period of a few weeks. The electric current for the combustion chambers is supplied by a small generator, and the mechanism is arranged to control a sufficient number of these chambers to obtain almost a continuous record. The principle used is similar to that of the Haldane apparatus, except that the control is mechanical and does not require constant attention.

The belief is expressed that due to the development of the principle of sheathing explosives, and research on their compositions, freedom from ignition underground will be assured. It is significant that last year no ignition of gas occurred, and many collieries were using sheathed explosives.

A sheathed explosive consists of the ordinary bobbin of explosive contained in waxed paper but surrounded by an extra layer of sodium bicarbonate. This bicarbonate is either held in position by a further layer of paper or it consists of a paper felt impregnated with sodium bicarbonate. When the shot is fired, the hot gases which are produced are wholly enclosed in a cloud of fine particles of this inert material, and cooling of the gases takes place so rapidly that there is very little danger of ignition of firedamp.

The obvious need for personal protection has been realized during the last few years, but at first considerable scepticism was displayed by managers and workmen with regard to the use of various items of apparel. It has been proved that many men have escaped serious injury due to the use of hard hats, gloves, shin guards, knee pads, safety boots and goggles fitted with safety glasses. The importance of this subject cannot be over-stressed, and much thought has been given to the production of these articles. More than 147,000 hard hats were supplied during the year, making a total of some 435,000 for the past three years.

Many of the special appendixes are reports of the district investigators on researches on the problem of falls of ground. These investigations are carried out under the direction of committees of local mining engineers, and a large amount of information is being collected on this extremely important subject.

* Sixteenth Annual Report of the Safety in Mines Research Board, including a Report of Matters dealt with by the Health Advisory Committee, 1937. Pp. 136+15 plates. (H.M. Stationery Office, 1938.) 2s. net.

Some Oxidation-Reduction Reactions

THE dihydric phenol catechol, 1,2-$C_6H_4(OH)_2$, has been widely used as a substrate in the study of the enzyme action of an oxidase, and it has been supposed that the utilization of molecular oxygen during the respiration of certain types of plants is largely dependent on such action. It was shown by Robinson and McCance in 1925 and others that the enzymatic oxidation of catechol involves the absorption of two atoms of oxygen per molecule of dihydric phenol, and it has been definitely established that *o*-benzoquinone is one of the initial products of the action of a phenolic oxidase such as tyrosinase on catechol. The conversion of catechol to *o*-benzoquinone theoretically requires only one atom of oxygen, and the fate of the second oxygen atom has been the subject of controversy. Since aerobic oxidations are often attended by the initial formation of hydrogen peroxide, it was suggested that the second oxygen atom was converted into hydrogen peroxide:

$$C_6H_4(OH)_2 + O_2 = C_6H_4O_2 + H_2O_2.$$

Onslow and Robinson, and Platt and Wormall, claimed to have detected traces of hydrogen peroxide in the enzymatic oxidation of catechol, and they attributed the difficulty of detecting this substance to its decomposition by peroxidase and catalase in the enzyme preparations. Others suggest that the decomposing activity of small amounts of some metals accounts for the removal of peroxide. Doubts have also been expressed as to the formation of hydrogen peroxide. Pugh and Raper in 1927 pointed out the possible decomposing action of catalase, and they suggested that the second oxygen atom might act by further oxidation of the *o*-benzoquinone. Nobutani in 1936 found that catalase has no effect on the oxygen consumption during the enzymatic oxidation of *p*-cresol, 1,4-$CH_3.C_6H_4.OH$, and hence concluded that hydrogen peroxide is not formed in this reaction.

C. R. Dawson and B. J. Ludwig[1] consider that the conclusions of Pugh and Raper and of Nobutani are not wholly convincing, since the strengths of the catalase preparations used were not indicated and it was not shown that the catalase remained active throughout the oxidation process. Keilin and Hartree in 1935 had also shown that under certain conditions catalase may promote a secondary oxidation involving the hydrogen peroxide formed during an enzymatic oxidation. When catalase so functions, the decomposition of the hydrogen peroxide does not result in the liberation of molecular oxygen and the return of this to the reaction system, and the formation of hydrogen peroxide would not be detected by oxygen uptake measurements.

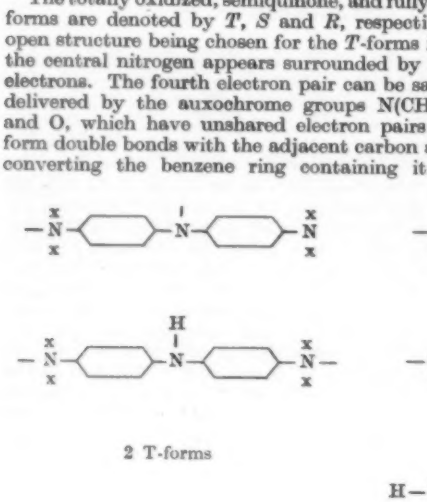
Dawson and Ludwig have used tyrosinase preparations having no peroxidase activity and negligible catalase activity in the oxidation of catechol. They made use of the fact recently discovered by Dawson and Nelson that the production of quinone by the enzymatic aerobic oxidation of catechol can be followed by titration with iodine, and when produced under certain conditions, for example, with an optimum amount of enzyme in very dilute solutions of catechol buffered in the *p*H range 4·2–6·6, the stability of the quinone is such that the stoichiometric relationship between it and the catechol can be demonstrated[2]. Since both quinone and hydrogen peroxide liberate iodine from hydriodic acid, the indefinite status of the hydrogen peroxide controversy tended to obscure all interpretations, and Dawson and Ludwig have attempted to clear up this point. Their tyrosinase preparations were obtained from the common mushroom by suitable purification, and the activity was measured by the method proposed by Graubard and Nelson. In dilute solutions buffered within the *p*H range 4·1–6·7, the oxidation product formed in the initial stages of the catechol-tyrosinase reaction was equivalent to two atoms of iodine per molecule of catechol, which corresponds to a benzoquinone. This quinone and hydrogen peroxide were shown to be incompatible in solutions buffered to *p*H values above 4·1. It was also shown that in the *p*H range 4·1–6·7 the course of the catechol-tyrosinase reaction, as followed by iodometric titration, was unaltered by large amounts of catalase or peroxidases.

Wagreich and Nelson[3] found that under condition. of low concentration of substrate, high concentration of enzyme, and *p*H 4·5–6·5, catechol is enzymatically oxidized by tyrosinase to *o*-benzoquinone with the consumption of one atom of oxygen only per molecule of catechol, and that the consumption of the second atom of oxygen is also catalysed by tyrosinase. They obtained evidence that a substance is formed when *o*-benzoquinone disappears in aqueous solution at *p*H 4·5–6·5 which is aerobically oxidized to a quinone by tyrosinase, and that the quantity of quinone compound formed in the oxidation of this substance corresponds to one half of the *o*-benzoquinone which has disappeared. It appears, therefore, that the second atom of oxygen used up in the enzymatic oxidation of catechol is concerned with the oxidation of a product resulting from the action of water on *o*-benzoquinone; that hydrogen peroxide is not responsible for any part of the titration values; and that the consumption of two atoms of oxygen per molecule of catechol cannot be attributed directly to the formation of hydrogen peroxide. The question whether or not hydrogen peroxide has an intermediary function during the formation of the initial quinone is still open to debate, but it is considered improbable that such a view of the enzymatic oxidation of catechol can be supported on the present evidence.

Another investigation on oxidation mechanism by a different method is the study of the possible intervention of semiquinone radicals as intermediate steps in oxidation-reduction reactions by G. Schwarzenbach and L. Michaelis[4]. The indophenol dyes had been the object of an extensive and fundamental investigation by W. M. Clark and co-workers, who measured the oxidation-reduction ('redox') potentials by electro-chemical methods. They concluded that there was no evidence for the existence of an intermediate step in the process of reduction but that in reversible bivalent oxidations two electrons always go on and off in pairs. Schwarzenbach and Michaelis now present evidence for the existence of such intermediate steps in the form of semiquinone radicals in the case of phenol blue and Bindschedler's green, two dyes closely related to the group investigated by Clark. Potentiometric redox titrations of these dyes were carried out at various *p*H values and the

slope of the titration curves indicates that an intermediate semiquinone radical is formed. The results were checked by spectrophotometric measurements.

The totally oxidized, semiquinone, and fully reduced forms are denoted by *T*, *S* and *R*, respectively, an open structure being chosen for the *T*-forms in which the central nitrogen appears surrounded by only six electrons. The fourth electron pair can be said to be delivered by the auxochrome groups $N(CH_3)_2$, OH and O, which have unshared electron pairs able to form double bonds with the adjacent carbon atom, so converting the benzene ring containing it into a quinoid ring. Both auxochrome groups can so participate and the molecule is a resonance system. The formulæ above apply to Bindschedler's green; similar formulæ are given in the paper for phenol blue and phenolindophenol. Each stroke represents an electron pair, and in the *S*-form the odd electron is provisionally shown by a dot as attached to the central nitrogen atom, although this is not to be regarded as assigning a definite position to it. Methyl groups are denoted by x.



2 T-forms

3 *S*-forms

5 *R*-forms

Titrations were mostly reductive, with reduced rosindulin *GG* and in a few cases titanous chloride. The air in the titration apparatus was replaced by hydrogen, and colloidal palladium ensured the removal of oxygen and produced a hydrogen potential which made possible the measurement of the *p*H of the buffer. In oxidative titrations the hydrogen was then replaced by nitrogen. Apart from the titration curves, the semiquinone could also be detected by its colour.

All three dyes showed strong semiquinone formation in the alkaline and acid range and comparatively small semiquinone formation in the middle *p*H range. The effect in the alkaline range may be explained as follows. In non-aqueous solutions the formation of *R* and *T* forms from a free radical is generally negligible, and only the equilibrium between the dimeric form and the radical occurs. Such solutions, however, correspond with a solution of very high *p*H, since the *R*-form cannot take up a proton. The sensitivity of the solutions to water follows from the proton donation of the water being equivalent to a strong lowering of *p*H by converting the *R*-form into *HR*:

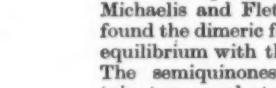
$$R + H_2O = RH + OH'$$
$$2S + H_2O = T + RH + OH'.$$

This is the main reason for the dismutation effect caused by the addition of water to the radicals.

The general treatment of oxidations and reductions of organic compounds must take account of the equilibria:

$$R \overset{e}{\rightleftarrows} S \overset{e}{\rightleftarrows} T$$
$$\updownarrow$$
$$\tfrac{1}{2}D$$

The reaction $D \rightleftarrows 2S$ in non-aqueous solutions is standard for the preparation of radicals; redox potentials refer to $R \rightleftarrows T$. The two processes were linked simultaneously by Friedheim and Michaelis[5] and Elema[6], who noticed the formation of free radicals in oxidations and reductions even in aqueous solutions. Michaelis and Fletcher[7] also found the dimeric form (*D*) in equilibrium with the radical. The semiquinones all contain two equal atoms (other than carbon) symmetrically located in the molecule, and these atoms can be regarded as carriers of an odd electron, e, which resonates symmetrically between the two positions, for example, as in Wurster's blue:



The older free radicals, on the other hand, contained one atom which might be considered as the carrier of the odd electron, so that it was reasonable to speak of tervalent carbon, bivalent nitrogen or univalent oxygen. These radicals were found to be very sensitive to water. The present investigation closes the gap between the two groups of radicals, examples of the second type having been found which exist in aqueous solution in equilibrium with *R* and *T* forms. As Hückel and Pauling have shown, all free radicals owe their existence to resonance energy, the odd electron and the π-electrons of the aromatic nuclei

not being in a definite position but appearing as a time average of charge distributed over a wide range of the molecule.

Schwarzenbach and Michaelis discuss in detail the relative stability of the molecules involved, that is, those given in the above and similar tables, on the basis of qualitative valency considerations. An atom in an 'ideal' state is assumed to be surrounded by four equal and indistinguishable electron pairs. Reactivity may then arise from: (1) a deviation from the stable electron number 8, for example, in the fluorine atom (oxidation-reduction instability); (2) a deviation from the ideal state of equality of the four electron pairs, for example, in the NH_3 molecule giving rise to basic properties (acid-base instability). It follows that the *R*-forms show primarily acid-base instability, which is great in alkaline solution; that the *T*-forms show greater instability (oxidation-reduction unstability) in acid solution; the radical *S* is stabilized by a resonance phenomenon differing from the resonance of the *T*-form ((*a*) *T*-form: resonance between two halves of molecule; (*b*) *S*-form: resonance of semiquinone type, which can be exhibited in one ring containing two nitrogen or oxygen atoms in symmetrical positions, *o*- or *p*-, but also in double rings, as in benzidine or γ,γ'-dipyridyl).

It is emphasized that practically none of the organic radicals known prior to the discovery of the semiquinones exhibit the peculiar type of strongly symmetrical resonance structure characteristic of the semiquinones. Correspondingly, these older radicals are usually not stable enough to be capable of existing to any appreciable extent in the presence of water, in contrast to the semiquinone radicals.

In a further paper, L. Michaelis, M. P. Schubert, R. K. Reber, J. A. Kuck and S. Granick[8] deal with a paraquinone, duroquinone (tetramethylbenzoquinone), which shows stability to alkalis. Potentiometric and magnetometric methods agree in showing that in sufficiently alkaline solution a free, strongly paramagnetic, semiquinone radical of brown colour is formed as an intermediate step of reversible reduction. This radical has no measurable tendency to form a valency-saturated dimeric form in the dissolved state.

Benzoquinone and hydroquinone form the solid quinhydrone, but no corresponding compound can be formed by ordinary methods from duroquinone. The dimeric form is assumed to be formed by hydrogen bonds

$$\left\{\begin{matrix}CO - H - OC\\ CO - H - OC\end{matrix}\right\}$$

involving a resonance between two fictitious structures in which alternately the one and the other half of the molecule (represented by brackets) is in the quinoid or benzenoid state. In orthoquinones there is no steric restriction in forming these bonds. In paraquinones, the two bonds can be formed only by applying the two rings flat upon one another. In duroquinone, however, the voluminous side-chains prevent a sufficiently close approach.

[1] *J. Amer. Chem. Soc.*, **60**, 1617 (1938).
[2] *J. Amer. Chem. Soc.*, **60**, 250 (1938).
[3] *J. Amer. Chem. Soc.*, **60**, 1545 (1938).
[4] *J. Amer. Chem. Soc.*, **60**, 1667 (1938).
[5] *J. Biol. Chem.*, **61**, 355 (1931).
[6] *Rec. trav. chim.*, **50**, 907 (1931).
[7] *J. Amer. Chem. Soc.*, **59**, 2460 (1937).
[8] *J. Amer. Chem. Soc.*, **60**, 1678 (1938).

New Satellites of Jupiter

In Nature of September 24, p. 564, reference was made to the various orbits that had been computed for Satellite x by Dr. Paul Herget and Dr. M. Davidson. Dr. Herget obtained two orbits with high eccentricities, exceeding 0·6, but the orbits differed essentially, one being direct and the other retrograde. As the latter gave smaller residuals, it was adopted, and it appeared that the least and greatest distances from Jupiter were 6 million and 30 million miles, respectively. As this last distance is probably outside the stable region for a satellite, it was obvious that further investigation was necessary before any definite pronouncement could be made.

Dr. Davidson's orbit was quite different from those of Dr. Herget. He found that the motion was direct, almost circular, and that the distance from Jupiter was about 7 million miles, but expressed some doubt whether it was just inside the orbit of Jupiter vi or outside that of vii.

Further observations have been made, and from these Dr. R. H. Wilson has computed a new orbit (Harv. Card 460). It now appears that the very eccentric orbit was in error and that the satellite has a small eccentricity, 0·14051, its mean distance from Jupiter being just over 7 million miles, as previously given by Dr. Davidson. Its inclination is 28° 24′ and its period of revolution 254 days. The satellite belongs to the same group as Satellites vi and vii, and it may be conjectured that there is a family of small satellites in this region, most of them too small to be detected. Even the existence of three is a puzzle. How did they originate? They are very far outside the Roche limit, and so cannot have been disrupted by Jupiter.

Dr. P. Herget has also computed an orbit for Satellite xi. It is moving in a retrograde orbit at an inclination to the plane of the ecliptic of 16·6° and a mean distance of 14 million miles from Jupiter. Its eccentricity is 0·207 and its period 692·5 days. The elements of the orbit will probably be improved later when more observations are available.

In a letter to Nature of October 8, p. 670, Mr. J. Miller suggested that the retrograde satellites followed an arithmetical progression law, not a geometrical progression law to which the direct satellites conformed approximately, and suggested that Satellite xi would be about 16 million miles from its primary. Actually the satellite does not obey either rule, but it is much closer to the arithmetical progression law than to the other. It is very remarkable that there are three satellites with direct motion, vi, vii, and x, at a distance of about 7 million miles, and three with retrograde motion, viii, ix, and xi, at distances between 14 and 15 million miles. Cosmogonists will find something here on which they can speculate.

Science News a Century Ago

The Trogon

Dr. Daubeny, who had recently returned from a visit to America and the West Indies, on November 12, 1838, at a meeting of the Ashmolean Society, Oxford, described some of the zoological specimens, including about sixty birds, which he had brought back and intended for the Ashmolean Museum. Among the birds was a very rare trogon, from the island of Cuba. Mr. Holme, of Christ Church College, observed that the specific name of the trogon was *Temnurus*, from the ends of the tail feathers appearing as if cut and spread out. The only other specimen in Europe was in the Museum at Paris and had been figured in Temminck's "Planches Coloriées". There was also an uncoloured figure, from a drawing by Colonel Hamilton Smith, in the seventh volume of Griffith's "Animal Kingdom".

Asiatic Society

At a meeting of the Asiatic Society on November 17, 1838, two of the communications read were from Dr. Falconer, superintendent of the Honorable East India Company's Botanical Garden at Saharanpore, in lat. 30° N. The first referred to the cultivation of plants in the garden likely to become important articles of commerce. The tea plant was thriving in the nurseries in the neighbouring hills, the Otaheite sugar cane had been a success, the Egyptian cotton seemed likely to thrive, while among other plants mentioned were the Ceylon cinnamon, American annotto, Bombay mangoes and the Chinese litchee (*sic*). Dr. Falconer's other letter was written from Cashmere.

Another paper read was "On the Yellow Colour of the Barberry", in which Mr. E. Solly stated that the root of the common barberry, or *Berberis vulgaris*, was used for dyeing leather yellow, and that from experiments made by him in the Society's museum, he was convinced that the root would prove an article of considerable value to dyers.

F. J. V. Broussais (1772-1838)

November 17 marks the centenary of the death of François Joseph Victor Broussais, the founder of the so-called 'physiological medicine' and one of the most eminent physicians of his time. He was born at St. Malo on December 17, 1772, qualified in Paris in 1803, took part in the Napoleonic campaigns in Holland, Germany and Spain, became physician-in-chief to the Val-de-Grâce Military Hospital in Paris, and was the author of several works of which the principal are the following: "Histoire des phlegmasies ou inflammations chroniques" (1822), "Examen de la doctrine généralement adoptée" (1816) and "De l'irritation et de la folie" (2nd edition, 1839). The main features of his doctrine were the denial of specificity, the attribution of all diseases to gastro-enteritis and the reduction of therapeutics to the application of leeches and a restricted diet. His teaching, which for many years had an enormous vogue, was finally overthrown by P. C. A. Louis.

M. Gaudin's Lime Light

On October 19, 1838, M. Gaudin had shown some experiments to the Paris Academy of Sciences on his new method of illumination. On November 17 the *Mechanics' Magazine*, under the heading "Substitute for the Sun", said: "The newly-invented light of M. Gaudin, on which experiments were recently made in Paris, is an improved modification of the well-known invention of Lieutenant Drummond. While Drummond pours a stream of oxygen, through spirits of wine, upon unslaked lime, Gaudin makes use of a more ethereal kind of oxygen, which he conducts through burning essence of turpentine. The Drummond light is fifteen hundred times stronger than that of burning gas; the Gaudin light is, we are assured by the inventor, as strong as that of the sun, or thirty thousand times stronger than gas." M. Gaudin "proposes to erect on the island of the Pont Neuf in the centre of Paris, a lighthouse, five hundred feet high, in which is to be placed a light from a hundred thousand to a million pipes strong, the power to be varied as the nights are light or dark. Paris will thus enjoy a sort of perpetual day; and as soon as the sun of the heavens has set the sun of the Pont Neuf will arise."

Horticultural Society

In its column of "Weekly Gossip", the *Athenæum* of November 17, 1838, said: "We understand that in consequence of the disturbed state of Mexico, and the difficulty of obtaining any package from that country, because of the rigour with which the French squadron maintains the blockade of Vera Cruz and Tampico, the Council of the Horticultural Society have decided upon withdrawing their collector, Mr. Hartweg, and sending him to investigate the botany of the State of Guatemala. The mountainous region, which cuts this magnificent country into two parts, and which abounds with most noble vegetation to an elevation of more than 13,000 feet above the sea, cannot fail to afford Mr. Hartweg a rich harvest. . . ."

University Events

Cambridge.—An appointment to a research studentship at Christ's College will be made at the end of July 1939. Candidates must be men who will have graduated before October 1, 1939, at some university other than Cambridge, and who have not commenced residence in Cambridge at the time of election. Preference will be given to those who will by then have already devoted at least a year to research. Every candidate must declare that he intends, if elected, to proceed to the degree of Ph.D. in the University of Cambridge. Further information can be obtained from the Master, Christ's College, Cambridge.

Oxford.—P. M. Medawar has been elected to a fellowship at Magdalen College for his work in zoology. Dr. K. N. Bahl, Merton College, has been granted the degree of D.Sc. for his work on earthworms. The following have been elected to Theodore Williams scholarships: C. W. M. Whitty, Brasenose College (pathology); G. I. M. Swyer, St. John's College (anatomy); W. D. M. Paton, New College (physiology).

The Rolleston Memorial Prize for 1938 has been divided between Dr. N. V. Polunin, Christ Church and New College, and H. M. Sinclair, Magdalen College.

Societies and Academies

Edinburgh

Royal Society of Edinburgh, October 24.

J. L. Baird: Development of television. The discovery of the light-sensitive properties of selenium led to many schemes for the accomplishment of television. These schemes remained theoretical until 1926, when Baird succeeded in transmitting true images by television. An experimental television service with his apparatus was commenced by the B.B.C. in 1929 and continued until superseded by the present ultra-short wave transmissions. The various systems used for large screen television were discussed. The progress of colour television was described.

Paris

Academy of Sciences (*C.R.*, 207, 605–648, Oct. 10, 1938).

P. Montel: Families of restricted non-uniform holomorph functions.

A. Caquot, J. Villey and P. Blanchet: Law of inflation of geometrically similar pneumatic tyres for aircraft.

R. Bourgeois: Daily exploration of the atmosphere by *radio-sondes*; its development on land and on sea. From near Trappes (Seine-et-Oise), a *radio-sondes* has been released daily since January 1, 1938; the altitude of the bottom of the stratosphere varied from 7,200 m. to 14,600 m., and the lowest temperature recorded was − 73°, on January 21 at 12,500 m. *Radio-sondes* have also been released from the *Carimaré*, cruising about 1,800 km. west of the Azores; the bottom of the stratosphere varied from 11,000 m. to 15,000 m., and the lowest temperature was − 68°, on May 4, 31 and June 16.

A. Guillet: Precise measurement of the acceleration g of the fall of bodies in a vacuum.

A. Marcelin: Increase of the velocity of a mineral oil at rest.

G. Ribaud: A differential pneumatic micrometer.

M. Rouault: Structure of the molecule PCl_5 by electron diffraction.

P. Brun: Study of the electric phenomena which accompany the formation of organo-metallic compounds of calcium and of aluminium.

P. de Beco: Oxidation reaction at the positive pole in electrolysis by a spark.

A. Berton: Comparative study of the visible and ultra-violet of mineral oxides and of their hydroxides and hydrates.

P. Bary and J. Herbert: Determination of the density of glasses by the law of additivity.

M. Paić: Determination of the sedimentation constant with the aid of ultra-centrifuges without an observation system.

C. Bedel: Solubility of some slightly soluble silver salts. Solubility has been found of the halides produced by double decomposition.

C. Legoux: A lithium phosphide.

Mlle. Y. Khouvine and F. Valentin: 'Tritylation' of α-*l*-sorbose.

M. Frèrejacque: Some heterosides of weakly basic amines.

R. Souèges: Embryogeny of the Boraginaceæ: development of the embryo in *Lycopsis arvensis* L.

E. Kahane and Mlle. J. Lévy: Water-soluble cholines of blood and of organs.

H. H. de Balsac: Ornithophile commensalism of staphylinid Coleoptera: its determinism by the thermal requirements of maturation of the gonads.

A. Peyron: Mode of symmetrical division of the amnio-ectoblastic vesicules in the embryonic buds in multiple tissue tumours of the testicle and its analogies with the polyembryony of the armadillo.

Brussels

Royal Academy (*Bull Classe Sci.*, 24, Nos. 8–9, 1938).

G. Cesàro and J. Mélon: The plane method for the identification of crystallizable substances. Study of the lamellæ of $Na_2S_2O_3$, $5H_2O$ deposited by a thin film of its aqueous solution on a plane sheet of glass. New zone of faces parallel to the binary axis.

L. Derwidué: The fundamental surfaces of the birational transformations of four-dimensional space.

Moscow

Academy of Sciences (*C.R.*, 20, No. 1, 1938).

B. Fuchs: Localizometric analytical figures.

S. Soboleff: A theorem of function analysis.

I. Berstein: Fluctuations of almost periodic motion of an auto-oscillating system.

S. I. Kretschmer and S. N. Rshevkin: Direct observation of Rayleigh waves in the case of total reflection.

M. Kozodaev and G. Latyshev: Pulse chopper of the Geiger-Müller counter.

M. Kozodaev: A tube circuit for the Geiger-Müller counter.

W. M. Pletz: Organic derivatives of scandium and yttrium.

A. V. Nikolaiev and N. M. Selivanova: Synthesis of hydroboracite.

V. A. Plotnikov and D. P. Zosimovich: Galvanic cells in the formation of alloys.

A. N. Fedorov: Mode of occurrence of Permian deposits in the neighbourhood of Kirillov.

N. V. Kagan: Influence of bacteriophage on phagocytosis.

E. N. Shmargon: New data on the morphology of rye chromosomes.

H. F. Kushner and O. N. Kitaieva: Blood composition in sheep and in their hybrids with *Ovis polii karelini* (Sev.) in connexion with the power of acclimatization.

A. S. Kasparyan: Haploids and haplo-diploids among hybrid twin seedlings in wheat.

M. E. Neuhaus: An additional method of studying gene action.

A. S. Krujilin, V. I. Samoilov and M. S. Shestialtynov: Change of carbohydrate and nitrogen content in sunflower under the influence of irrigation.

B. S. Moshkov and I. E. Kocherzhenko: Optimal light conditions for the cultivation of *Cinchona succirubra* Pav. at Sukhumi.

E. G. Andreeva: Macro- and micro-structure of metacarpal bones in some breeds of sheep.

A. I. Ibikhimovich: Growth of extremities in tadpoles on heterotropic transplantations.

Forthcoming Events

[*Meetings marked with an asterisk are open to the public.*]

Monday, November 14

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Dr. H. A. Brouwer: "Exploration in the Lesser Sunda Islands".

Tuesday, November 15

UNIVERSITY COLLEGE, LONDON, at 5.—Dr. L. Margaret Kerly: "Muscle Chemistry" (succeeding lectures on November 22 and 29).*

EUGENICS SOCIETY (at the Royal Society), at 5.15.—Prof. C. Spearman: "Intelligence Tests".*

LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE, at 5.30.—Dr. H. Lyndhurst Duke: "The Pathogenic Trypanosomes of Africa and the Tsetse Flies (*Glossina*) that Convey Them" (succeeding lectures on November 16 and 17).*

KING'S COLLEGE, LONDON, at 5.30.—Dr. R. Pendennis Wallis: "Steam Boiler Plant" (succeeding lectures on November 22 and 29).*

GRESHAM LECTURES (at Gresham College, Basinghall Street, E.C.2), at 6.—A. R. Hinks, F.R.S.: "A Retrospect to Herschel" (Gresham Lectures, succeeding lectures on November 16, 17 and 18).*

Thursday, November 17

ROYAL SOCIETY, at 10.30.—Discussion on "The Protein Molecule" to be opened by Prof. The Svedberg.

ROYAL COLLEGE OF PHYSICIANS, at 5.—Prof. J. B. S. Haldane, F.R.S.: "Some Problems of Human Congenital Disease" (Lloyd Roberts Lecture).

CHEMICAL SOCIETY, at 8.—Prof. W. N. Haworth, F.R.S.: "Some Carbohydrate Problems".

Friday, November 18

UNIVERSITY COLLEGE, LONDON, at 5.30.—Dr. Julie Moscheles: "Some Aspects of the Geography of Czechoslovak Cities".*

ROYAL INSTITUTION, at 9.—R. M. Lockley: "The Seabird as an Individual: Results of Ringing Experiments".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned.

LECTURER IN MECHANICAL ENGINEERING in the Battersea Polytechnic, London, S.W.11—The Principal (November 21).

PRINCIPAL of the Paddington Technical Institute—The Education Officer (T.1), County Hall, S.E.1 (November 24).

SENIOR SCIENTIFIC OFFICERS, SCIENTIFIC OFFICERS AND JUNIOR SCIENTIFIC OFFICERS (physics, mathematics or engineering) in the Admiralty Scientific Pool—The Secretary of the Admiralty (C.E. Branch. Quote ref. No. C.E. 9791/38. November 25).

PHYSICIST to the British Cotton Industry Research Association—The Director of Research, Shirley Institute, Didsbury, Manchester.

SENIOR LECTURER IN MINING in the University of Melbourne—The Secretary, Universities Bureau of the British Empire, 88A, Gower Street, W.C.1.

Reports and other Publications

(*not included in the monthly Books Supplement*)

Great Britain and Ireland

A. R. P.: a Report on the Design, Equipment and Cost of Air-Raid Shelters. (Reprinted from *The Architects' Journal* for July 7, 1938.) Second edition. Pp. 15–48. (London: Association of Architects, Surveyors and Technical Assistants.) 1*s.* [2010

Institution of Civil Engineers. Subject-Index to (1) Minutes of Proceedings, Vols. 225–240, (2) Selected Engineering Papers, Nos. 57–180; Sessions 1927–28 to 1934–35. Pp. iii+83. (London: Institution of Civil Engineers.) [2110

Report of the Government Chemist upon the Work of the Government Laboratory for the Year ending 31st March 1938; with Appendices. Pp. 48. (London: H.M. Stationery Office.) 9*d.* net. [2110

Sale of Food and Drugs. Extracts from the Annual Report of the Ministry of Health for 1937–38 and Abstract of Reports of Public Analysts for the Year 1937. Pp. 17. (London: H.M. Stationery Office.) 4*d.* net. [2110

The Price of Peace: Notes on the World Crisis. By Harold Macmillan. Pp. 20. (London: Printed for Private Circulation.) [2210

Proceedings of the Royal Irish Academy. Vol. 44, Section A, No. 10: Diffraction by Irregular Gratings. By Prof. R. W. Ditchburn. Pp. 123–138. 1*s.* Vol. 44, Section B, No. 11: Salmon of the River Shannon. By Arthur E. J. Went. Pp. 261–322+plate 10. 5*s.* Vol. 45, Section B, No. 1: Contemporaneous Slumping and other Problems at Bray Series, Ordovician, and Lower Carboniferous Horizons, in County Dublin. By Archie Lamont. Pp. 32+7 plates. 4*s.* Vol. 45, Section B, No. 2: The Cytoplasmic Bodies in the Oogenesis of the Vulture (*Neophron percnopterus ginginianus*) and the Effect of the Ultracentrifuging of the Oocytes of the Pigeon. By Dr. B. N. Singh. Pp. 33–64+plates 8–12. 3*s.* 6*d.* (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [2210

Institution of Gas Engineers. 10th Autumn Research Meeting, London, 1st and 2nd November 1938. Communication 190: 43rd Report of the Joint Research Committee of the Institution and Leeds University—The Investigation of the Use of Oxygen and High Pressure in Gasification, Part 3: Synthesis of Gaseous Hydrocarbons at High Pressure. Pp. 64. 2*s.* Communication No. 200: Some Results attained with Solid Fuels used in Open Grates for Heating Living Rooms. By Dr. W. Davidson and Dr. Harold Hartley. Pp. 48. 2*s.* (London: Institution of Gas Engineers.) [2210

Annual Report of the Director of the Meteorological Office presented by the Meteorological Committee to the Air Council, for the Year ended March 31, 1938. (M.O. 428.) Pp. 61. (London: H.M. Stationery Office.) 1*s.* net. [2610

North Staffordshire Field Club. Transactions and Annual Report, 1937–38. Edited by H. V. Thompson. Vol. 72. Pp. 130+A249–A288. (Stafford: Allison and Bowen, Ltd.) 7*s.* 6*d.* [2610

Other Countries

Field Museum of Natural History. Anthropological Series, Vol. 23, No. 2: Anthropometry of the Ovimbundu, Angola. By Wilfrid D. Hambly. (Publication 426.) Pp. 21–80+30 plates. 1 dollar. Zoological Series, Vol. 22, No. 4: A New Catalogue of the Fresh-water Fishes of Panama. By Samuel F. Hildebrand. (Publication 425.) Pp. 215–360. 1.50 dollars. (Chicago: Field Museum of Natural History.) [2010

U.S. Department of Agriculture. Miscellaneous Publication No. 305: The Horseflies of the Subfamily Tabaninae of the Nearctic Region. By Alan Stone. Pp. 172. (Washington, D.C.: Government Printing Office.) 20 cents. [2010

Publications of the Observatory of the University of Michigan. Vol. 7, No. 5: Distribution of Sunspots in Longitude. By Rassi Marie Losh. Pp. 127–146. (Ann Arbor, Mich.: University of Michigan.) [2010

Collected Papers on Wave Geometry. Compiled by the Seminar of Geometry and Theoretical Physics of the Hiroshima University. Pp. iv+336. (Tōkyō: Tyūbun-Kan.) 8*s.* net. [2110

Journal of the Faculty of Agriculture, Hokkaido Imperial University. Vol. 45, Part 1: Further Studies on the Influence of the Water Temperature on the Water Absorption and the Stomatal Aperture. By Takashi Tagawa. Pp. 34. (Tokyo: Maruzen Co., Ltd.) [2110

Ingeniørvidenskabelige Skrifter. Nr. A46: The Gliding Process and the Metallurgy of Copper and Lead among the Pre-Columbian Indians. By Paul Bergsøe. Translated from the Danish by C. F. Reynolds. Pp. 58+5 plates. (København: G.E.C. Gad.) 2.00 kr. [2110

Geological Survey of British Guiana. Bulletin No. 8: Memorandum on the Occurrence of Bauxite in British Guiana. Compiled by D. W. Bishopp from Reports on the Examinations carried out between 1917 and 1921 by E. E. Winter under the direction of Sir J. B. Henderson, and from other Sources. Pp. iii+68. (Georgetown: Geological Survey of British Guiana.) 24 cents. [2110

Imperial College of Tropical Agriculture: Low Temperature Research Station. Memoir No. 8: The Low Temperature Research Station, 1937. By C. W. Wardlaw and E. R. Leonard, with the collaboration of C. T. Watts. Pp. 12+14 plates. (Trinidad: Imperial College of Tropical Agriculture.) [2110

Polska Akademia Umiejętności. Starunia, No. 15: O utworach morenowych Łysej Góry pod Wilnem (Sur les dépôts glaciaires de Łysa Góra près Wilno), par Antonina Jaroszewicz-Klyszynska; Wyniki próbnych badań kilku moren Polski środkowej i północnej (Résultats des recherches pétrographiques d'essai sur les moraines du centre et du nord de la Pologne), par Antonina Jaroszewicz-Klyszynska. Pp. 64. (Kraków: Polska Akademia Umiejętności.) [2210

Académie Polonaise des Sciences et des Lettres: Comité des Publications Silésiennes. Travaux géologiques, No. 3: Les mégaspores du Bassin Houiller Polonais. Deuxième partie: Le groupe marginal. Par Jan Zerndt. Pp. 78+24 plates. (Kraków: Polska Akademia Umiejętności.) [2210

An Operative Quantum Atom. By Thomas Marshall, Jr. Pp. 28. (Chicago: The Author, 105 West Adams Street.) [2410

U.S. Department of Agriculture. Circular No. 487: Selecting Fertilizers. By Albert R. Merz. Pp. 16. (Washington, D.C.: Government Printing Office.) 5 cents. [2410

Annales de l'Institut de Physique du Globe de l'Université de Paris et du Bureau central de Magnetisme terrestre. Publiées par les soins de Prof. Ch. Maurain. Tome 16. Pp. iv+304+6 plates. (Paris: Les Presses universitaires de France.) [2610

Smithsonian Miscellaneous Collections. Vol. 97, No. 9: A New Nuthatch from Yunnan. By H. G. Deignan. (Publication 3486.) Pp. ii+2. (Washington, D.C.: Smithsonian Institution.) [2610